BRANCH No. 3

Oct. 22 '08

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OCTOBER 22, 1908.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 31. 505 PEARL STREET, NEW YORK. No. 43.

Index to Advertisers and Classified Index Following Reading Matter.

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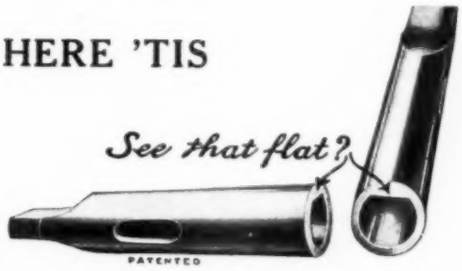

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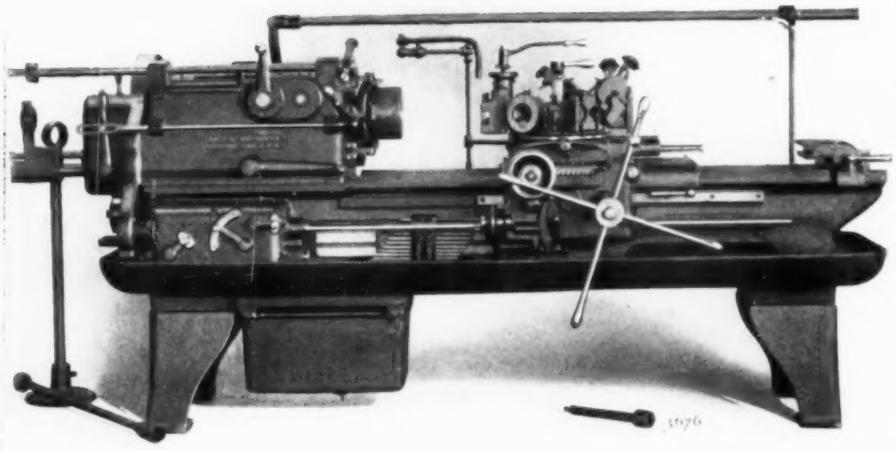

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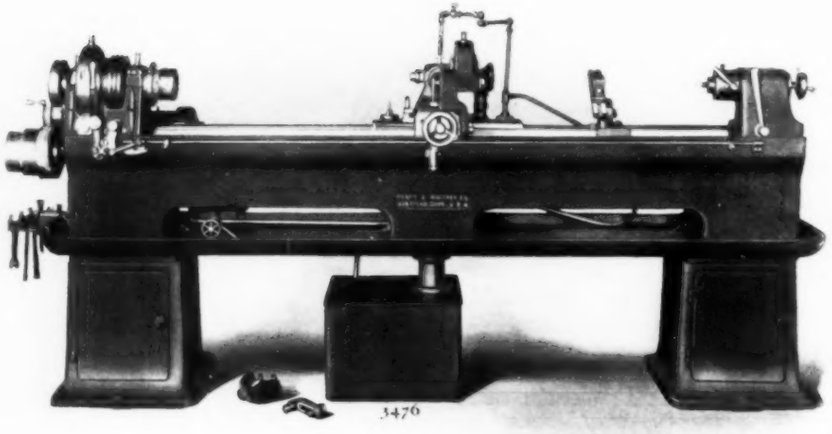

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Method of Leveling and Alining Planers

The Proper Setting of a Long Planer Bed Is Accomplished by Suitable Adjusting Blocks, Straight Edges, Level and Alining Apparatus

BY JAMES J. THOMPSON*

Many interesting and valuable articles have appeared recently upon the subjects of bolting down planers, leveling, etc., and in this connection a description of the methods employed in alining the planers in the shops of the American Tool Works Company may be of interest. The details are somewhat novel and considering the results obtained should appeal to all who have work of this character to do.

The planers in use in the shops are inspected at regular intervals and any discrepancies in alinement corrected, thus keeping this class of tools in a high state of accuracy.

We will follow this operation in connection with an old type 72-inch by 72-inch by 31-foot planer, of an Eastern make, it having been recently rebuilt by the American Tool Works Company, who have replaned bed and table and substituted a new steel gearing, shafts and rack for the old parts; the photographs having been made while the planer was being mounted upon a new foundation, this particular machine being selected because of its bed being made from two sections, the joint coming just back of the housings. This fact, together with the proportions of side walls to length, etc., made the operation a very delicate one. The table is 31 feet long and the bed is 55 feet over all and being of old design was very flexible, but after the alinement was completed no variation greater than 0.0005 inch could be detected at any reading.

Foundation

The foundation may be of some interest, this being the point from which all accuracy must be obtained, consequently its solidity must be a very important item in all alinements. The foundations under all these machines are made of rock and concrete and are carried to a good depth dependent upon the soil in which they are located. The planer under discussion has a foundation of solid concrete over 4 feet deep, 6 feet wide for full length of bed and 10 feet wide at housing seats. Directly under the gearing a metal tank is let into the foundation to catch any dripping oil that would destroy the foundation. This tank is about 2 feet deep and of sufficient length to thoroughly protect the concrete; it is accessible for draining when filled. No bolts are provided for bolting the bed to the foundation, this being taken care of by means of a series of standard adjusting blocks which take the thrust and hold the planer in any position desired as will be shown below.

Leveling Blocks

Fig. 1 shows several views of the standard adjusting block, the details of which can be clearly seen. The base plate *A* is of liberal dimensions and provided with flanges to hold it in the concrete after the setting is made and to secure a firm footing for the bed to rest upon. The bottom plate is planed inside to take the wedge block *B* and faced at the slot to take the adjusting screw *C*. Two lugs are provided at the end which take the adjusting screws *D*, which are provided with lock nuts. The wedge block *B* is planed on top, bottom and sides and works freely between the side walls of bottom plate *A*. This block is tapped to take a fine-threaded screw *C* of liberal diameter, this screw working in the slot of plate *A*, as shown. It will be noted that the adjusting screws *D* operate in the opposite direction from the elevating screw *C*, thereby placing the machine to be lined under perfect control. The type of wedge block commonly used has no such features and often moves the bed out of alinement when it is being leveled.

Locating the Blocks

The foundation is leveled and made as smooth as possible, after which the adjusting blocks are set in depressions which are provided when the foundation is made. The depressions are deep enough to allow the flanges of plate *A* to come below the surface enough to allow grout to be filled in upon them. The blocks are located about every 4 feet each side of the housings and somewhat closer at housing and gearing centers in order to minimize the vibration of the parts.

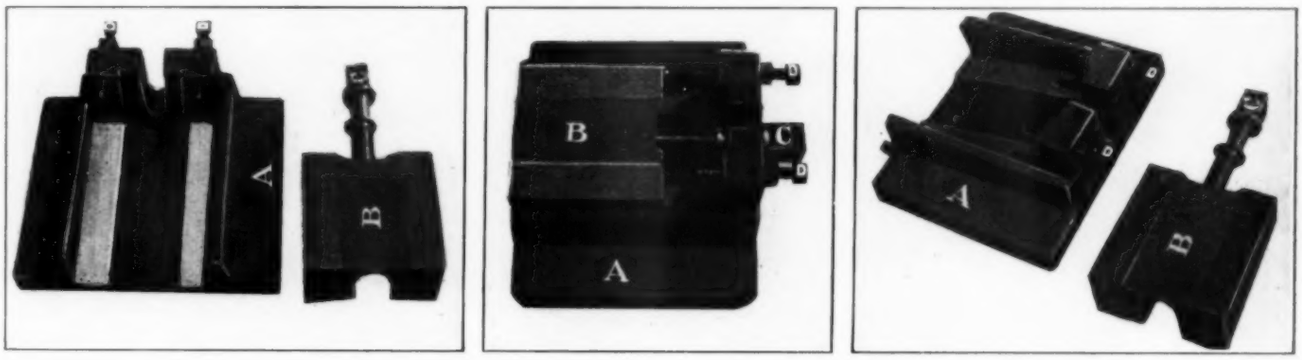


FIG. 1. ADJUSTING BLOCKS FOR PLANERS

In this particular illustration, the adjusting blocks are shown with the screws toward the outside, but they can be as readily used on the inside if the shape of bed will permit. The planer bed is set upon the blocks and alined, after which the blocks are grouted in with cement and the intervals between the blocks under the bed side walls are filled with sulphur. The adjusting screws are thoroughly slushed with an anti-rust compound and a removable box built up around the blocks. This acts both as a protection to blocks and a running board for the operator, and allows of ready access to screws for adjustment at any time. The screws, etc., can be placed below the floor line if desired, but this company favors the floor-line foundation for this style of planer, as it brings the table up to a good working hight. The adjusting blocks should be set to approximately the same hight by means of a long straightedge. This will save quite a little time and labor after the bed is set upon them.

*Superintendent, planing department, American Tool Works Company.

The Leveling Process

The leveling process is somewhat different from that usually followed, although the articles used consist of the usual very accurate spirit level, straight edge and parallel strips with ground cylinders to fit into the V's.

It will be seen in Fig. 2, that three cross-parallel bars are used together with three sets of duplicate cylinders which are accurately tested as are the parallels. An 8-foot straight-edge and an 8-foot parallel for the level are used on top of the cross bars. Thus a setting is made at one end of the bed and readings taken from the level over each V and between them and then the bar is set diagonally across the parallels to check any tendency to wind. After this is done the straight-edge is used with tissue paper under it as shown; the paper must be tight under all points to be level. This straight-edge is a check on the level. The second and successive settings are made by taking out the first parallel cross bar and placing it ahead of the first setting and the straight-edge and level bar moved up, leaving two cross parallels in the original setting and the third bar must always line up with two before it. A metal-to-metal contact is made between cross bars and level bar and any variations can be detected by tapping the bar lightly on top. After the leveling process has been completed and the adjusting blocks are permanently located, the parallels, etc., are removed and the alining apparatus applied to either V of the bed.

The Alining Apparatus

It consists of the following parts: Two blocks *A A* are planed so as to be duplicates and to fit the V. At one end of the blocks are located uprights which carry tension screws *B*, and at the opposite ends of the blocks are located knife-edged posts *C* to act as guides for the gage wire. A notch is planed in both posts so as to be exactly in line. The photograph shows a short wire between the two end V-blocks, but in reality the blocks are placed at opposite ends of the bed and a fine piano wire is stretched between them. The blocks are securely clamped to the bed and sufficient tension put on the wire to make it tight enough to give about 1/32 inch sag in 50 feet. The wire will not stand much greater

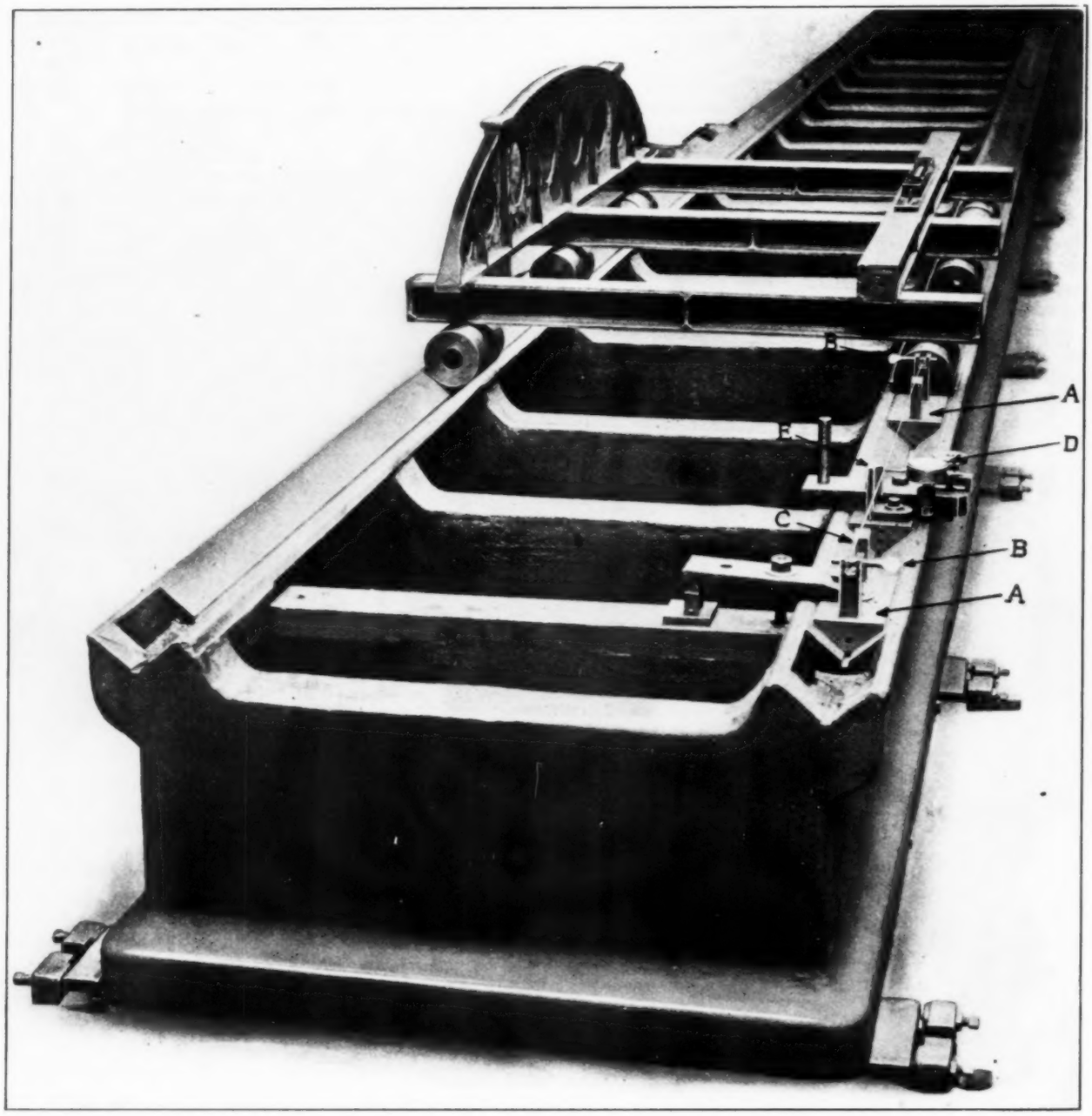


FIG. 2. PLANER LEVELING AND ALINING APPARATUS

strain. The tension of the wire does not affect the alinement to any degree, it being necessary to hold the sag down to within the range of the end of the indicator stem only.

After the wire has been stretched, a third V-block is placed in the V; this block carries the indicator for reading the variations and the indicator consists of a plate adjustably mounted on the V-block and having an arm to take a standard dial indicator *O*. Mounted on another slide and directly opposite the indicator stem is a post *E*. This gage post has a leveled face toward the indicator and a small flat for the wire to bear against; the post is adjustable to and from the wire.

How the Indicator is Used

The indicator is moved to the ends of the bed and readings taken by holding the free end of the indicator stem between the thumb and second finger, the first finger being used to steady the hand. The stem of the indicator should be allowed to just touch the wire. To facilitate this reading a piece of paper should be placed under the wire. Any deflection can readily be seen and a memorandum of the reading should be chalked on the bed at this point. Take the first readings at the opposite ends of the bed to make sure everything is secure and then proceed to "line up" the whole length of the bed. The gage post *E* should be set about 0.015 inch away from the wire, and is used merely as a comparison point. It should be understood that the wire must not be used to deflect the indicator, but the indicator should deflect the wire at any point not in line with either end, the difference between the two readings being obtained by subtracting the last reading from the initial record at the ends of the bed. These results should be noted on the bed at points over the adjusting blocks and after the first test is made the adjusting screws *D*, Fig. 1, should be set up to push or pull the bed to either side desired, as shown by the readings; then the operation is repeated, readings are taken until the bed is in perfect alinement, after which all lock nuts are set.

After the alining is completed a second test is made with parallel bars and level to note whether any discrepancies exist after the blocks are set for alinement.

Setting Blocks Under Short Planers

There is no tendency for this bed to travel endwise owing to its weight and the shape of the bottom as it has a rib all round underneath, which is set into the cement, but on short planers where high cutting speeds are used, the adjusting blocks are set at the ends at right angles to the side blocks and also under the housing seats, thus firmly locking the beds to the foundations.

This concern has no planers on wood floors, but should the adjusting blocks be used under such conditions, the flanges of the lower plate are drilled for lag screws for bolting to the floor.

A further word about the foundation of planers may serve as a warning to some: A foundation should be thoroughly dry and solid before a permanent setting can be secured, as experience has shown that the shrinkage of the cement even for several weeks after being completed has caused planers to become crooked after a very careful setting originally. It is necessary to go over the setting and back off the side screws in the adjusting blocks slightly until you feel assured that there is no further movement possible. The tendency is to shrink sideways more than up or down, which nearly always throws the V's out of line while they still remain level.

An Up-to-date German Chain-testing Plant

By Dr. Alfred Gradenwitz

Owing to the continual increase in the displacement of both war and mercantile vessels, more exacting requirements have had to be coped with in constructing ship-chains, and special plants have had to be provided for the testing of these chains for stretch and for breaking strength. The machinery used in connection with these plants is obviously of far greater dimensions than the older type of such machinery, and in order to permit manufacture as cheaply as possible, allows inexpensive testing to be carried out on a commercial scale. These requirements are met by a carefully designed measuring method, and by absolutely convenient machines equipped with efficient chucks and operating devices.

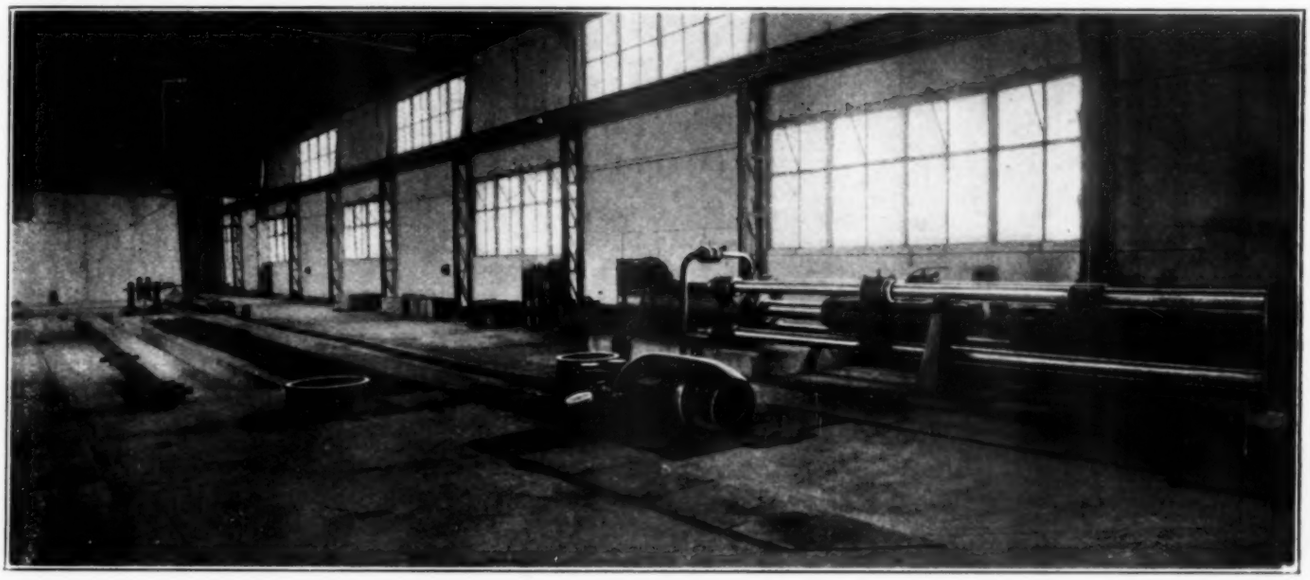


FIG. 1. A GERMAN CHAIN TESTING PLANT

One of the most interesting modern plants of this kind is the chain-testing floor of the Borsig works in Upper Silesia, which, owing to its rolling-mill equipment for seamless chains, is especially adapted for manufacturing the heaviest and strongest types of chain. As the products turned out at this works are at least 20 per cent. stronger than any other kinds of chain of equal dimensions, machines of an especially substantial design are required for testing them. This applies primarily to the chain-breaking machine, yet the chain-stretching machine had to be designed substantially as well. This chain-testing plant, which has been in operation for about two years, comprises, in addition to the two testing machines just mentioned, high-pressure and low-pressure hydraulic accumulators and pumps with their piping and a special testing room in which the

controllers and measuring instruments are located.

The chain-stretching machine is able to stretch chains made of links up to 100 millimeters (4 inches) in thickness, and up to 30 meters (90 feet) in length. The chain-breaking machine is designed for breaking 3 to 5 links of the same size.

Fig. 1 shows the arrangement of the machines on the testing floor. Both are identical in construction, and are distinguished only by their size. They comprise a working cylinder by means of which the chains are held under the action of low-pressure hydraulic accumulators, and stretched or broken by a high-pressure accumulator provided with several pressure stages which correspond to the various strengths of chains. On the opposite side of the machines is located the measuring outfit, which consists of a bronze-lined measuring cylinder in which runs a plunger, also lined with bronze and tightened by means of a leather sleeve. Between the cylinders and plungers is inserted liquid, the pressure of which is read at any time from the manometers installed on the testing floor; special checking manometers insure an extreme accuracy of readings.

A special patented chuck, shown in Fig. 2, is used to hold the chain. This readily allows any chain or chain links to be gripped or released by a simple manipulation. The principle underlying its construction is the tongs principle.

Method of Testing

The process employed in the testing (stretching or breaking) of chain links is as follows:

After having been taken to the stretching machine, by means of electrical capstans over partly adjustable and conveniently arranged idlers, a chain 27 to 30 meters in length is gripped in the chuck just described (by simply opening and closing the tongs) and secured by a locking lever. Low-pressure water having then been supplied to the low-pressure accumulator from the testing floor, a preliminary tension is imparted to the chain, and a very sensitive regulating device is used to supply to the working cylinder the pressure actually required. This pressure is maintained on the chain as long as required, or increased by stages as prescribed by certain methods of testing, in connection with which a very sensitive controller, installed on the testing floor, is found especially convenient.

After thus submitting the chain to its test, the working cylinder is returned to its initial position by shifting the controller, after which the chain is released by opening the chuck, and placed beside the testing trough for examination by the proper official. The same process is repeated in connection with the breaking machine, but the chain (which in this case comprises only 3 to 5 links) is inserted in the machine by hand (in the case of smaller chains) by an electrical traveling crane (in the case of larger chains), instead of by means of an electrical capstan. The stretching and breaking tests are thus performed so rapidly as to allow a considerable number of tests to be carried out in a single day. In addition to the regular testing work made for the factory in order to check the products of manufacture, tests on delivery are thus carried out readily by special officials with a limited staff.

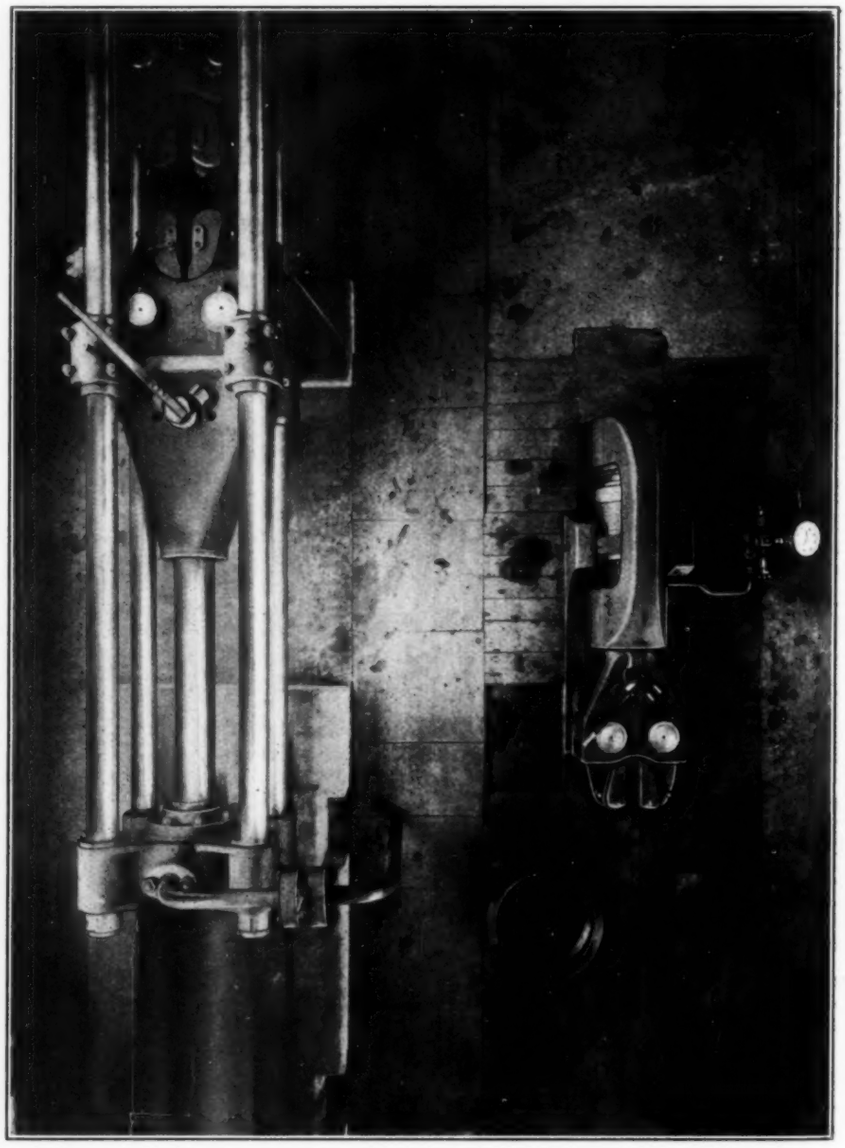


FIG. 2. TONGS CHUCKS FOR GRIPPING THE CHAINS IN THE TESTING MACHINES

It may be said that if the stretching machine were of as substantial design as the breaking machine, and provided with a proper connecting member for gripping short links, the same machine could be used in carrying out both stretching and breaking tests. However, the reduction in the first cost of such a combined machine would fail to make up for the greater trouble in handling it and the surplus in working cost, apart from the unavoidable nuisance due to the alternate stretching and breaking. This is why the possibility of combining the two kinds of machine has been left out of consideration. The additional expenditure has been amply repaid, even during so short a working period.

The principal features of hydraulic measuring machines should finally be pointed out. These afford the advantage over the lever-and-balance method of strictly uniform results, with far simpler and better arranged mechanisms and machines. Whereas the old measuring method, especially in the case of considerable forces, required a complicated system of levers, knives, etc., which with the slightest shock was liable to give unreliable results. Such accidents are entirely excluded with the hydraulic apparatus. By providing a checking rod, the accuracy of the hydraulic measurements can be ascertained at any time.

The Royal Testing Office of Gross Lichterfelde has examined the machinery

and hydraulic apparatus above described; it is stated that the expenditure of energy can be ascertained with absolute safety by a simple reading of the manometer pressure with the aid of a special constant, established by the office, a checking more accurate than is possible in the case of any other method.

The chain-testing plant of the Borsig works may be said to constitute a fully reliable and most perfect arrangement for testing (stretching and breaking) all kinds of chain. It is superior to any other similar plant, both in regard to the design of its machinery, simplicity of operation and reliability of results..

The Care of Silent Chain

By J. R. Shays

Now that high-speed silent-running chains are being used so extensively throughout the country the question comes up as to the proper care they should receive in order that the best results may be obtained. There has been more or less trouble with these chains caused by ignorance of certain requirements on the part of those whose business it is to keep the machinery of the plant in proper order. The trouble has been caused in most cases by lack of proper lubrication and can be easily avoided if the following conditions are looked after.

If these chains are observed closely it will be seen that they are composed of numerous small parts, which in a way accounts for their noiseless operation as well as their ability to run at high speeds. The trouble chiefly lies in the fact that thick lubricants or graphite have been used, which may be all right for ordinary chains but cannot be used to any advantage with these chains as it does not reach the inner joints. Also in some cases the chains have been exposed to dust and the gritty substances getting into the numerous joints clog the chain, causing faulty operation and a lot of wear. In places where dust and grit cannot be avoided, the drives should be incased in a dust-proof casing.

For lubrication of this type of chain a high-grade cylinder oil should be used or a lubricant called "chain oil" which is manufactured especially for this work and is sold by one of the concerns selling this style chain. The oil should be applied at least two or three times a week. A good practice is to oil at noon every other day, the oil being applied with a brush on the teeth of the chain when it is running at a low speed in order that all the joints may be thoroughly lubricated. In cases of drives where such a high chain speed is developed that the oil is thrown off, it is advisable to run the lower part of the chain in an oil bath. In this manner the chain will be running through oil and there will be no chance of the joints running dry and burning.

In cases where the chain becomes stiff and refuses to work properly it should be removed and treated to a bath in kerosene and thoroughly cleansed until all the stiff joints work properly, then after replacing and lubricating there should be no further trouble from this source.

Milling Machine for Parallel Surfaces

The special type of milling machine shown herewith is built by J. E. Reinecker at Chemnitz, Germany, for milling parallel surfaces and has several advantages for this class of work. The two spindles can be set as desired and, milling both sides at once, it saves resetting with its possible inaccuracies and also avoids distortion by heat, as both sides are heated equally and at the same time. This is especially useful on long thin work.

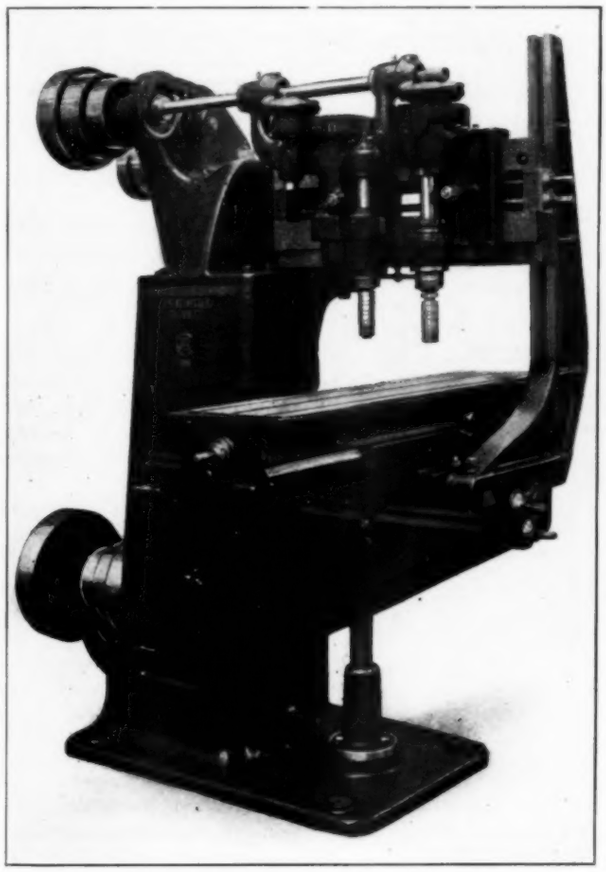


FIG. 1. FRONT OF PARALLEL MILLING MACHINE

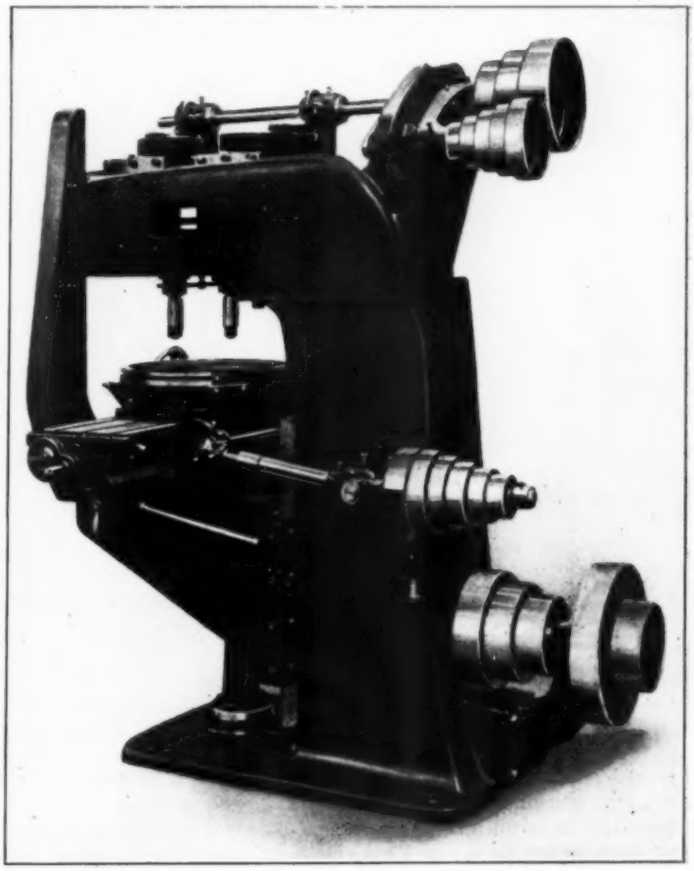


FIG. 2. REAR VIEW SHOWING FEED CONES

The construction is a modification of the usual plain milling machine with the milling heads supported on the rail or slide and tied to the knee by the standard shown. Both heads can be easily moved and one has a vertical adjustment so that both cutters can be readily set to the same distance from the table.

The drive is clearly shown and the feed is taken from the horizontal shaft by the

spur gears near the cone. Both longitudinal and cross-wise feeds have automatic trips. All screws have micrometer collars for fine adjustment.

Its use is not confined to milling both sides of one piece, but these machines are being used by boiler-fitting manufacturers, for cutting keyways in two shafts at once and similar work. A circular table is also made for milling round parts and connects with the automatic feed.

In the machine shown the table is 10⅞x45 inches on its working face, has automatic feeds 29½ inches in length and 19¾ inches across, is 25⅝ inches between upright and supporting standard, has 6 spindle speeds and 10 table feeds, the circular table is 15¾ inches and is driven by a 4⅜-inch belt.

Keeping Track of Jigs and Other Special Tools

By Chas. Moon*

In this article is described a system for keeping track of tools, jigs, etc., that has been in operation for some time and has proved successful in the manufacture of electrical machinery, in what is called the small-tool department.

The company by whom I am employed having decided several years ago to start a department for the manufacture of small parts for their motors and generators, I was put in charge of the department and given four employees, three machine tools and a few jigs. The department has grown so rapidly that today we have about forty-five employees and some sixty machines consisting of many specials and an equipment of standard machine tools that embraces everything from the automatic screw machine down to the common grindstone. There are now more than two thousand small jigs, tools and templets, all of which are more or less complicated and the need of some means whereby they can be kept track of can be readily seen.

We started in by having several sets of shelving built in various places in the department and we numbered each section and lettered each shelf, then numbered every jig or tool and made a record on a 4x6 card, Fig. 1, giving all information such as where the jig was used, what it cost and what it was for. We then placed the jig or tool in the section nearest to the place it was used and that section number and shelf letter were stamped on the jig and written on the 4x6 card. The marking on the jig then looked like this: "24 H 1", 24 being the serial number of the jig, H the shelf and 1 the section of shelves.

All of the company's products are identified by a letter or combination of letters, and we prepared guide cards to represent each and every complete machine and under those headings or guide cards we have a list like Fig. 2, of all tools used on that size machine. This enables us to tell at a glance just what is required to build each machine and acts as a guide to the drawing room in designing new machines to hold as many parts as possible to certain dimensions. On the upper right-hand corner of all our drawings is a list giving the numbers of what jigs and tools we have for the piece shown on that drawing. This has proved a great advantage as it enables the foreman or workman to tell at a glance just what jigs he wants and whether there is a jig or tool for that particular job.

On the serial 4x6 cards we are now placing a record of the time required to complete the operation that the jig is intended for, which gives us a chance to make our estimate in setting premium time limits.

The card index is a perpetual inventory, for, as new jigs are made new cards are also made and when a jig is superseded or destroyed the card is taken out of the active box and filed under a separate heading for that purpose. Under a heading of specials is a complete list of all special taps, dies, pin drills, boring bars, milling cutters and forming tools, which is a great help in designing new work.

Each foreman has a card-index box which contains a record of what jigs and tools he has in his department and in the drafting room is a master file which contains copies of all parts.

This system has been in use for five years and has been very satisfactory. I give this description hoping that it may be of some service to the readers of the American Machinist.

H R	Tools for H. R. brush holder Patt. # 489-2	
24 H 1	For holding 489-2 while milling slot	
266 H 2	Cutter for " " for " "	
32 E 14	For holding " " while " lower edge	
70 E 14	Hardened plugs for filing radius on ends	
86 E 14	For drilling all holes	
52 E 14	" grinding face on Gardner grinder	

FIG. 2. INDEX CARD FOR TOOLS, ACTUAL SIZE 4X6 INCHES

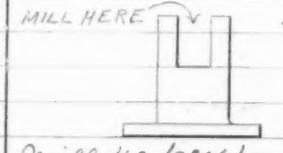
Jig No. 24 H 1 Made 4-7-06 Shop Ord. 494

Description of Operation — Supersedes

Used On

Depreciation — Jig for holding radial holder Pat #489-2 While milling

Date	Value		Superseded
7-1-06	$ 6 39	slot Use cutter #266 H 2	
7-1-07	5.76	41 R.P.M. .138 Feed	
7-1-08	5.19		



Material 1.49

Labor 4.90

Mill 40 per hour — Hours 11

Total Cost $6.39

FIG. 1. JIG RECORD CARD, ACTUAL SIZE 4X6 INCHES

The great strides that have been made by the suction-gas producer in combination with the gas engine are evidenced by the report that the British naval authorities are going to give the combination a trial on shipboard, and great things are expected of it. This is heralded as a new discovery, but it has been in the minds of naval engineers for a long time. As long ago as the St. Louis exposition, Admiral Melville in private conversation expressed the belief that some day the gas producer might displace the boiler afloat as well as ashore. At that time this appeared like a remote possibility, yet now the beginning seems to be right at hand.

*Foreman, small tool department, Triumph Electric Company.

Jigs for Machining an Oil Pump Body

Two Jigs or Fixtures for Continuous Milling Operations and Two Drilling Jigs, With Interesting Details for Locating and Holding Work

BY A. J. BAKER*

The tools here described were designed for the expeditious manufacture of the bodies of geared oil pumps, as made by the Cincinnati Milling Machine Company, for their new line of high-power horizontal and vertical millers.

Fig. 1 shows this casting. It is machined on the base, and on the face *A*, to which the cover plate is attached.

Holes are drilled in the base and in the face *A*. The two holes *C C* are bored and reamed, and the large recess *D D* counterbored. The holes *B B* for charging the pumps are drilled, as well as the holes for pipe connections.

Circular Milling Fixture

Fig. 2 shows the first milling fixture. This is mounted on a circular attachment, as built by the Cincinnati Milling Machine Company and applied to one of their vertical machines. It consists of one main

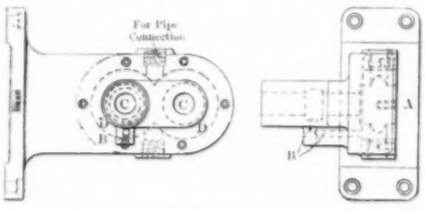


FIG. 1. THE PUMP TO BE MADE

casting *A* of circular shape, which is bolted by four ¾-inch bolts to the face of the attachment tables. This casting is of conical form, and is so made to facilitate the easy dispersal of the chips, which, falling upon the inclined face of the fixture, will work themselves by gravity down to its outer edges, and so fall through the spaces shown in the rim.

Around the rim of the main casting are eight bosses in which the clamp screws slide. The clamp plates have at their extremities two screws, which press against the base of the work and force its upper rounded part into the V-grooves in the central plate attached to the main casting. The clamp plate is beveled off on each end, bringing the central part to a line bearing on the shoulder of the clamp screw, and so enabling the clamps to adjust themselves to any irregularity in the work. The clamp screw has a 17/32-inch groove milled in its periphery. For part of its length this groove is cut parallel to the axis of the clamp screw, and finishes up in a spiral of ⅜-inch pitch. A hardened-steel screw *B* has its ½-inch end fitting in the clamp screw slot, and acts as a nut. The clamp screw in action is pushed toward the work, the slot sliding on the point of screw *B*.

When the end of the parallel portion of the slot is reached, the clamping points are close to the surface of the work, so that, approximately, a quarter of a turn in the spiral path locks the clamp. Clamp, plate and handle are of a low-grade tool steel, and are hardened. The fit of the screw in both plate and casting is very slack, and the groove has a 1/32-inch clearance over the point of screw *B*.

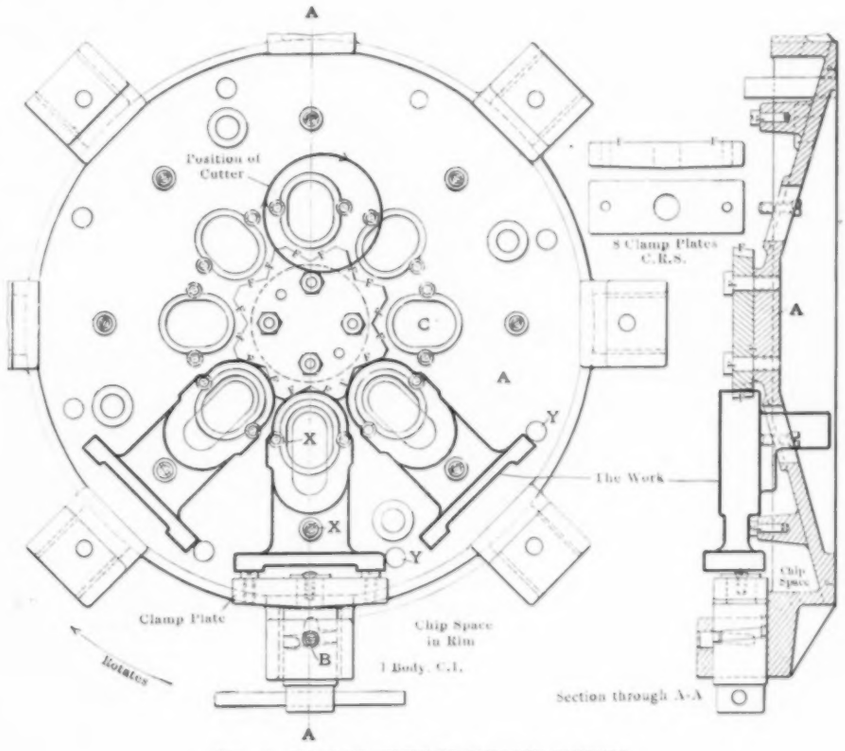


FIG. 2. PLAN OF CIRCULAR MILLING FIXTURE

The central plate in which the V-grooves are milled is of machine steel, case-hardened. The faces of the grooves are milled at an angle of 5 degrees toward the axis of the fixture. This insures the upper edge of the groove forcing the work down onto the three support screws. The end of the base rests against the stop pin *Y* which takes the pressure due to the direction of the cut. The holes *C* in the main casting are merely clearance holes in which the long boss of the work is placed, the rim around its edge being to prevent chips falling through the hole, and by resting on the table beneath the work, so disturb its alinement.

The Cutter and Cutting Speeds

The cutter used with this fixture is a plain end mill, 6 inches diameter, mounted on a steel arbor, and fitting directly in the spindle of the vertical mill. The fixture, in operation, rotates continuously at a speed of one-half revolution per minute, which gives an actual cutting feed of 14 inches per minute. The feed, however, is by no means the limit of production, as it will readily be seen that the labor of picking up, cleaning, and removing the work will determine a rate far below that which the machine and cutter are capable of attaining. Fig. 6 shows the fixture at work.

It is customary with this fixture for the operator to use a lead hammer, in order the more expeditiously to tighten and loosen the clamp screws, as they pass before him. As soon as a clamped and finished piece comes to the front of the fixture, the operator hits the handle of the clamp screw, releases the pressure and brings the parallel part of the ¾-inch groove in line with the screw. He then draws back the screw to get a sufficient clearance, takes out the work, inserts a fresh piece and clamps up the screw. One final tap with the hammer, as the fixture

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continues its course, makes everything secure.

It is obvious that a scheme of this nature is exceedingly economical; there is no idle return stroke, the cutter is constantly at work, the means of clamping are rapid and effective, and in addition are brought conveniently to the operator's reach. The chips do not have to be cleared away, and in the event of the operator missing a place, no harm is done. It is necessary that all the clamping parts should be strong and hard so that the operator may have no compunctions about pounding things up.

Milling the Feet

Fig. 3 shows the second milling fixture, used for milling the feet on the base. This is used on a No. 3 Cincinnati high-power horizontal machine, with automatic trip of the feed in both directions. The cutter used is a standard 2½-inch end mill. The main jig casting has four machined faces on which that part of the work finished in the circular fixture rests. The locating points are two screws *A* in the front edge of the fixture. The location sideways is provided for by a stop *B*.

The work is held on the fixture with a triangular clamp operated by a stout locking handle. The two points of clamp which rest on the work are set as widely apart as possible, while still being directly over the machined face. The locking handle is beveled off on the lower end to allow for variation in the thickness of the castings.

The two studs *C* on either side of the clamp are to prevent its swinging out of position.

In operation, the fixture is filled up with four castings and the feed started. As soon as the cutter has completely passed one of the pieces the operator unclamps the finished piece and inserts a fresh one. By this time the cutter has passed the second piece, which is also removed and a fresh one substituted, and so on, until the original four have been removed and fresh pieces are in their places. During all this time the table has been feeding in a left-hand direction, but by setting the automatic reverse stop close up, the feed reverses and the table returns with the cutter acting first on the last inserted piece and finishing up in the original position.

By this time another load is on board and the journey begins again. This arrangement, as in the case of the first fixture, gives an almost constant cut, the only time wasted being at the ends of the cut and this can be reduced to very small proportions. The feeds and speed used in this case are 12 inches per minute feed, and 50 feet per minute cutting speed.

Drilling Jigs

Fig. 4 shows the jig for first drilling operation. This includes the boring of the two holes *C, C*, Fig. 1, the counterboring of the recess *D*, and the drilling and tapping of the six holes, by means of which the cover plate is attached to the pump body.

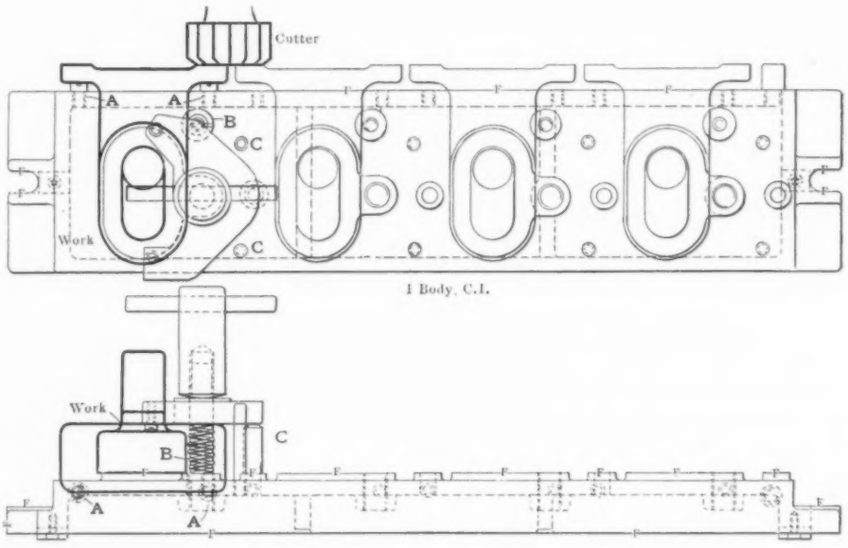


FIG. 3. MILLING THE FEET

The fixture consists of two main parts and a clamp; the upper part is hinged in the lower and carries all the drill bushes. It is fastened to the lower casting by the clamp *A*, which has a clamping face, eccentric with its axis, and beveled off to suit the angular face on the end of the upper or swinging piece. Side play is prevented by the swinging plate fitting be-

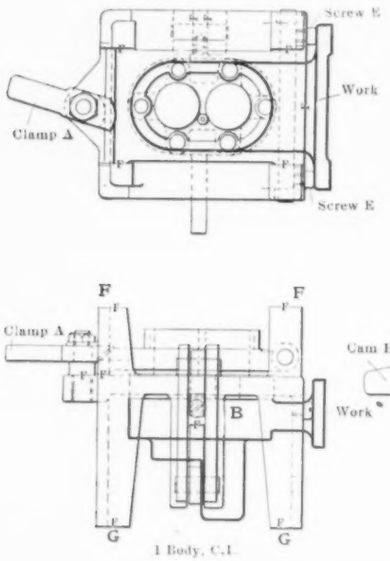


FIG. 4. DRILLING FOR SIDE PLATES

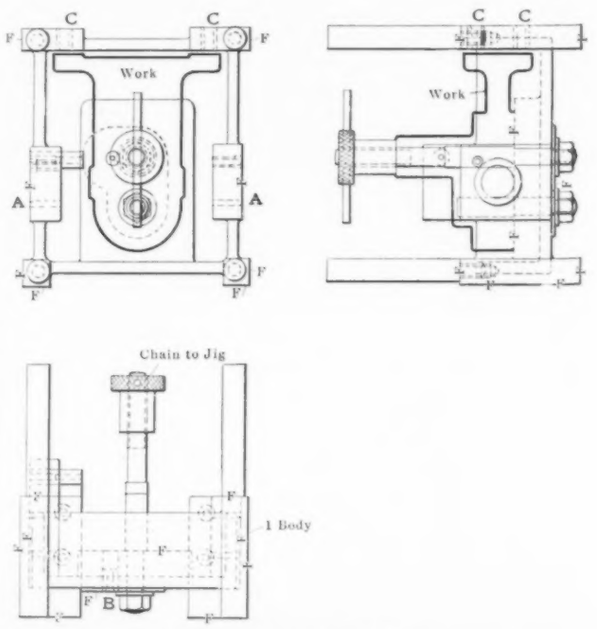


FIG. 5. DRILLING THE FEET

tween the machined faces on the inside of the upper part of the jig. The lower part has on its underside a machined surface *B*, against which the milled face of the work is clamped. Pivoted on a stud driven through the down-hanging boss is the clamp plate, which contains a 5/16-inch headless screw, forced against the work by the action of the cam handle *C*, transmitted through the links *D*. The same locating points are utilized on this jig as on the second milling fixture, i.e., two screws *E* against which the top part of the base rests.

In operation, the jig rests upon the faces *F*, while the work is clamped in position with one movement of the clamping lever. It is then turned over, resting on the faces *G*, and with the top plate locked in position is drilled with a standard 43/64-inch twist drill, guided in the bushes shown, which reach down to within ⅛ inch of the counterbored face.

The bushings are removed, and a four-fluted spiral reamer trues the holes up to within 0.003 inch of the finished size. An adjustable reamer finishes the hole to 11/16 inch standard. Both of these reamers are guided in bushings.

The six screw holes are next drilled and tapped, after which the upper plate of the fixture is released and swung out of the way, and the 2-inch recess *D*, Fig. 1, counterbored, using both roughing and finishing cutters, which are mounted on shanks provided with revolving bushes fitting the holes *C*. The clearance is then bored, using a four-fluted counterbore.

The fixture is then turned over to the original position, and the top of the long boss faced off, using the counterboring cutters for this purpose. The working of the jig is simple and rapid, and has the following good points: First, simplicity of chucking; second, rapidity and accuracy in locating jig plate; third, the "running out" of drills is made of as little consequence as possible, as their starting point is at the place where the gears mesh; fourth, ease of access for gaging. The jig is used on a four-spindled drill, one spindle of which is fitted with a tapping head. Two spindles carry roughing and finishing counterbores, and the fourth spindle fitted with presto chuck, handles all the drills.

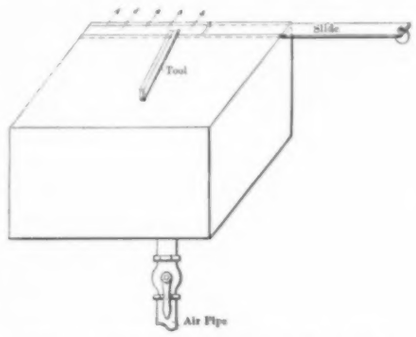


FIG. 1. FAN BLAST BOX FOR AIR COOLING STEEL

Fig. 5 shows the second drill jig, in which are drilled the holes in the base, charging hole, inlet and outlet holes. The work is located on the same milled face as in the two preceding operations, with this addition that its position on that face is determined by two hardened and ground plugs fitting in the holes *C*, *C*, bored in the jig last described. The upper end of one of these plugs is threaded for a hand nut, the threads of both nut and screw being cut away to allow of quick locking.

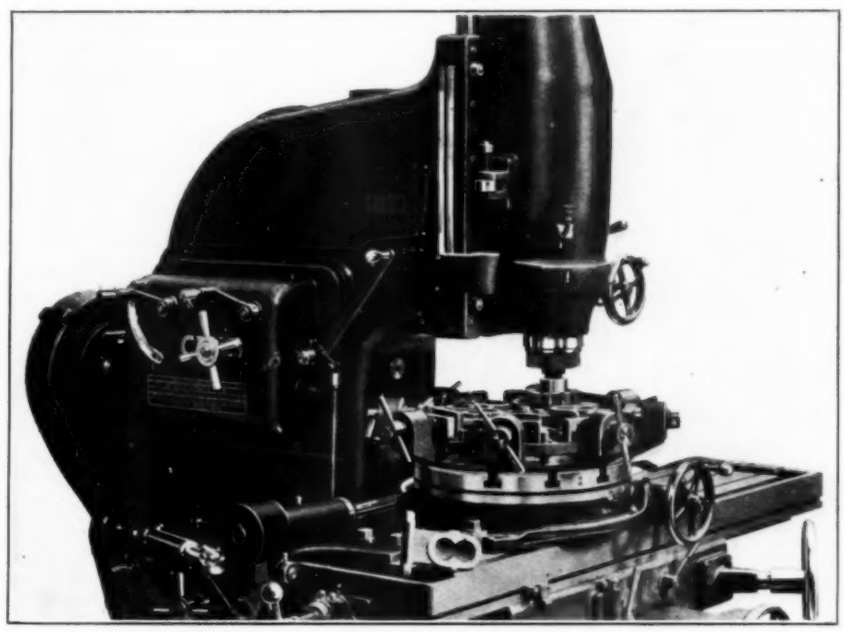


FIG. 6. THE CIRCULAR FIXTURE AT WORK

Two Air-cooling Devices

By Ethan Viall

Recently, in response to a request for a plan of a cooling apparatus, for use in our hardening room to cool high-speed lathe and planer tools, Charles Burgess, of the Cyclops Steel Works, sent us the accompanying sketches, and as anyone is welcome to use them, they may be of interest to some of the army of readers of American Machinist.

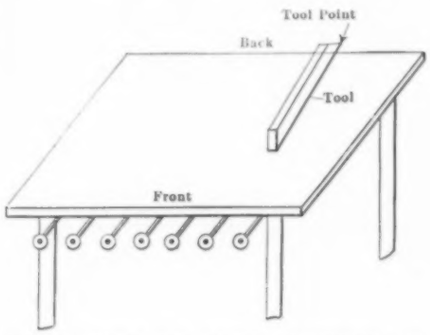


FIG. 2. TABLE FOR USING COMPRESSED AIR

Fig. 1 is a box arranged for cooling tools when air from a fan is used. The box may be made all metal or of wood with a metal top. The slide shown, is for the purpose of shutting off part of the blast when only a few tools are to be cooled and the arrows show the current of air. In a box arranged in this way the current of air strikes just right, that is a little back of the cutting edge of the tool and passes off at its point. This is the best fan blast cooler for this class of tools that I have seen.

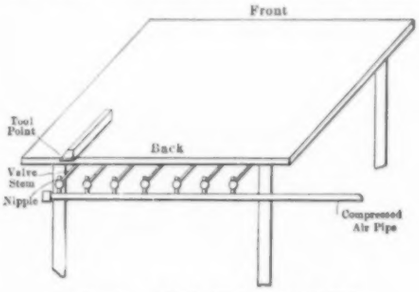


FIG. 3. BACK VIEW OF TABLE

Figs. 2 and 3 are two views of a cooling table for use when compressed air is used. On this table as many tools may be cooled as there are jets. The valves have long stems which extend clear under the plate and they may be turned on or off from the front.

The plate used may be of boiler iron or a slab of cast iron and anyone can easily fit up the necessary pipes, valves and jets. In some cases it would perhaps be better to use small steam cocks or gas jets and open them from the side they are on, instead of using the long valve stems. This, of course, depends a good deal on the way a man is used to handling his tools and the situation of the table.

Design of an English High-Speed Steam Engine

Ample Proportions, Absence of Unnecessary Weight, Automatic Adjustments, Careful Balancing and the Best of Materials Are Important

BY PHILIP BELLOWS

To the student of engineering it must seem somewhat strange that in England and America two distinct types of steam engines have been developed during the last 25 years for the important work of generating electricity. On this side the horizontal engine held almost undisputed sway until the advent of the steam turbine and the large gas engine. Throughout Britain, however, the type of prime-mover most commonly met with, outside of the newcomers, is the modern type of vertical high-speed, inclosed, automatic engine, of which there are many well defined and distinct subdivisions. There are single-acting and double-acting engines, and there are forced-lubricating and splash-lubricating engines. It is the purpose of this article to consider an engine of the double-acting, splash-lubricating type.

It may be remarked, in passing, that the tendency in the old country has been to keep the size of the individual units within certain easily handled limits, so that it is the exception to find, even in very large installations, engines of more than 2000 to 2500 horsepower. Possibly one reason for this state of things is to be found in the smaller English loading-gage, which necessarily prevents the transportation of such large parts as are handled in this country. But a stronger reason no doubt lies in the fact that a small engine permits of more accurate workmanship and is, therefore, more suitable for the high speeds prevailing there. In general, the standard of design and workmanship is very high. Runs of 4, 6 or 8 months without stop or shut-down of any kind, whether for repairs, adjustment or any other reason, are not at all unknown.

The particular engine which I purpose to discuss in this article is known as the semi-superposed type. It may be characterized as a cross between a tandem and a side-by-side. This type has been developed by William Sisson at his works at Gloucester, England, and in its present form is a monument to his inventive genius, originality and persistence. The salient features of the design are numerous and noteworthy. A glance at Fig. 1 will indicate a few of them.

In general the frame of the engine is a box-like iron casting, whose sides taper inward. The crosshead guides are cast inside and integral with it, as are also the various brackets to carry the valve gear. In machining the frame, the seats for the main bearings are bored, after which a specially made jig is fitted to these seats and this jig takes the end of the boring-bar which is used to bore out the guides.

The crank-shaft, Fig. 2, is unusually liberal in its proportions; the crank-pins, instead of being set at 90 degrees, are set at 180 degrees, like those of a double-opposed gasolene engine. These crank-shafts have no middle bearing, hence the large size of the crank-pins and main journals. The forgings from which these cranks are turned out are noteworthy. They are made from billets of gun steel; in fact, they are samples of the steel from which the guns of the British navy are made. It is unusually hard and tough, with a tensile strength of 95,000 to 100,000 pounds per square inch.

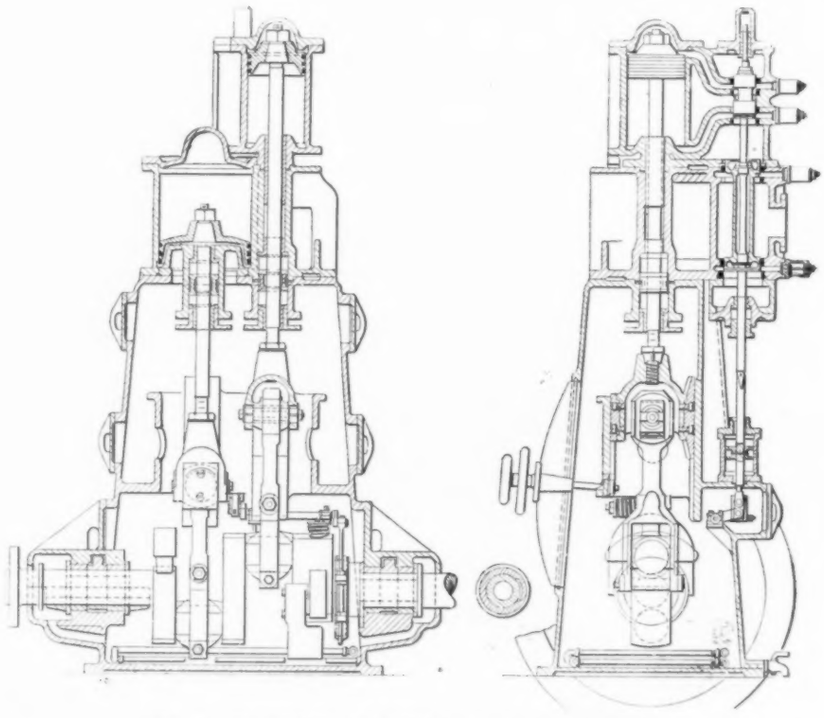


FIG. 1. SECTION OF AN ENGLISH HIGH-SPEED ENGINE

The Main Bearings

The main bearings are of phosphor bronze. It will be noticed that care is taken to support the weight of the fly-wheel, without wasting costly metal, by making the lower bearing adequate in length to its needs and without making the upper half to correspond in unnecessary symmetry. It is usually a difficult matter to induce oil to travel onto the surface of a bearing under pressure, unless means are provided to cause it to do so. To this end, therefore, a wide and deep channel is cast in each side of each top and bottom bearing, which not only permits oil to flow the whole length of the journal, but relieves the latter of dangerous side-pressure in case of overheating, and gives it a chance to get through with no more damage than a slight excess of heat which can be taken care of without stopping the engine. Adequately cut oil-channels in the main brasses, combined with the sweep of the journal, distribute the lubricant to all parts of the bearing.

A small end elevation, Fig. 5, shows one of the bearings from the outside; a cross-section shows the relief at the sides of the brasses (Fig. 1). Attention is called to the two big holding-bolts of the bearing-cap. An enlarged view is given in Fig. 6. Mr. Sisson has used this type of bolt for many years in all places throughout engine-construction where parts are subjected to heavy shocks; for such purposes as holding down the engine bed where foundations are inadequate, in crank-pin brasses, crosshead brasses, etc. I believe that the idea was adapted from armor-plate practice. The theory is that a bolt so made will, upon sudden shock in the way of tension,

stretch in the reduced portion instead of stripping the thread or snapping. Its application in armor-plate is as a means of holding the plate to the ship's side, so that upon the impact of a heavy shell the holding bolts will stretch slightly. With plain bolts it was found that, upon the terrific blow of a shell, the bolts would either snap, or the nuts would strip and fly across the ship like bullets.

A striking feature of the engine is the provision for automatically taking up wear while running. We will now see how this is accomplished.

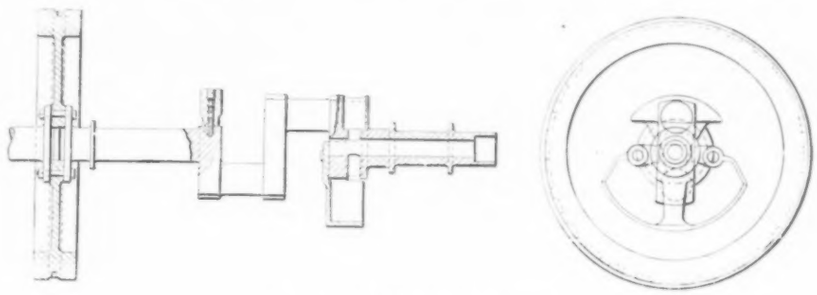


FIG. 2. CRANK-SHAFT DETAILS

The Connecting Rods

The main connecting rods are steel forgings of unusual shape. By reference to Fig. 3 see the peculiar features. It will be noted that the crank-pin brasses can accommodate themselves to the crank-pin in two directions, vertically and laterally. It will also be noticed that the brasses do not inclose the entire pin, but only cover an arc subtending an angle of about 120 degrees on top and bottom. The spaces at the sides are entirely cut away. This is done for two reasons: to save in weight of metal at a point where weight reduction leads to great gains in well-balanced running, and also to permit a liberal supply of oil to reach the crank-pin as the shaft churns the oil bath in the base of the engine.

Mention has been made of the long runs to which engines of this type are sometimes subjected; a slight reflection will show how important it is to avoid any strain in the nature of a twist or wind in bearings of such length, as it is almost impossible to avoid a very slight winding or eccentricity in comparing the motion at one end of the crank-pin with that of the other. Many factors come into play in the process of making a one-piece crank-shaft which are liable to cause this: an error of 0.004 or 0.005 inch in drilling the crank-pin centers, unequal annealing in the forging causing unequal wear on the centers in turning, a slight eccentricity of the live center in the lathe (a common error in large lathes); such discrepancies as these, which are almost impossible to avoid, are quite sufficient oftentimes to bring about an error of 0.003 to 0.004 inch in parallelism of crank-pin and crank-shaft axes. For these reasons the lower brass is mounted on a steel sleeve pinched tightly between the jaws of the connecting-rod fork. Freedom is permitted between fork and brass to the extent of about 0.004 inch. The surfaces of each are machined and then scraped by hand to a true fit. The brasses are of phosphor bronze, bored and scraped by hand. The upper half of the brass is fitted to the connecting-rod fork with the same degree of accuracy as the lower, and is provided on its upper surface with a machined portion scraped to a true sphere.

Against the latter presses a pad piece of swedish bessemer steel (a kind of steel made by a modification of the bessemer process, using swedish iron as a basis and producing a metal that lends itself admirably to case-hardening), shaped like an inverted mushroom. The upper and lower surfaces of the latter are case-hardened and polished highly. The wedge shown passing through the connecting-rod is of tool steel also hardened and polished and is held in place by a powerful coiled spring. The angle of this wedge is 1 to 4 and its upper surface bears against the hardened end of a swedish bessemer-steel plunger sliding in the bored-out trunk of the connecting-rod. This plunger bears against the lower gudgeon brass through the medium of a steel pad piece, and the upper brass bears directly against the upper end of the connecting-rod. This upper brass is made a tight fit in its place, but the lower one is free to slide. Great care is taken to insure the hardness and smoothness of the various hardened surfaces, as upon these qualities depends the successful working of this type of adjustment. The angle of the adjusting wedge was chosen as a compromise to permit of the various parts freeing themselves in case through heating the bearing pressure should become excessive. Attention is taken to insure that the supply of oil shall at all times be ample to all parts needing it. The crossheads are steel castings with slippers of hard, close-grained cast iron, turned to fit the bored guides.

By referring to the cross-section in Fig. 1, it will be seen that the slippers are attached to the crosshead by means of a portion turned to fit snugly into a bored recess. This makes a neat and mechanical job, amply strong to resist any shearing strain in case the guides should heat and seize. Thus the sole function of the two fillister-head screws is to hold the parts together; they have no shearing strain to resist.

Swedish bessemer steel is used for the gudgeon, which is hollow and split at the ends to permit two steel cones to be inserted and pulled inward to tighten the crosshead gudgeon. A key prevents it from turning in its bearings, which are bored a light driving fit. The sides of the gudgeon are flattened to prevent the formation of a rib as the brasses oscillate back and forth.

It will be noticed that the outer crosshead slipper is shorter than the inner one by about one-third. As the only period in which this slipper is bearing is at the ends of the stroke, with the piston cushioned, it is obvious that with practically no thrust the wear on this part must be light; hence, a characteristic reduction of weight in a fast-moving part.

The piston-rod stuffing boxes are provided with glands of ample length in addition to the bronze lantern bushings. The latter are free to slide with the packing and permit of an even distribution

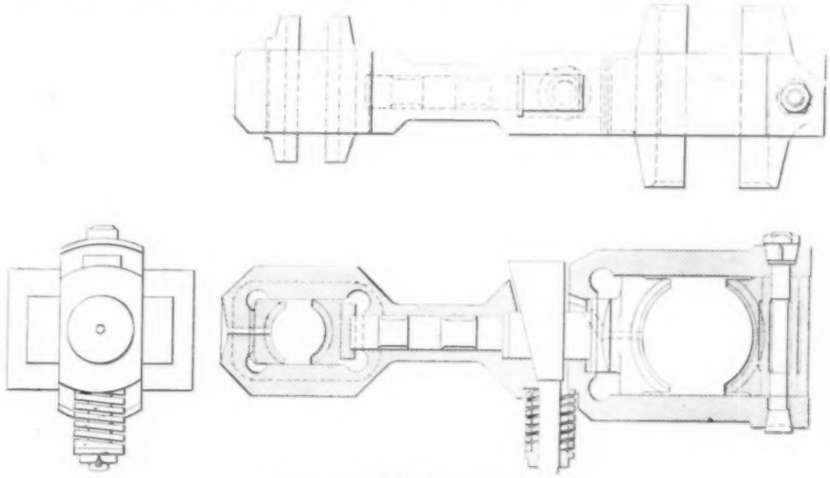


FIG. 3. CONNECTING-ROD DETAILS

in pressure. A drain pipe, which is not shown in the illustration, leads from these parts to the outside of the engine to take care of any condensed water that may collect.

The Pistons

The low-pressure piston is a cast-steel dish machined smooth on its upper and lower faces to reduce condensation, bored conical with a taper of 1 in 4 for the piston-rod and fitted to the cylinder with a clearance all round of about 0.004 inch. Three cast-iron rings made eccentric and cut in the thinnest part serve to keep the piston tight. The method of locking the piston into the crosshead has been evolved with much thought to avoid any tendency to work loose under the rapidly alternating tension and compression strains. The high-pressure piston is of solid cast iron. Through the front of the main casing is a large circular opening permitting of thorough access to the engine. A sheet-steel disk, turned up on the rim and having its edge machined, fits into this opening and is held against a circular machined surface in the manner shown in Fig. 1. Any oil from the return splash which may soak through this joint is retained by a circular groove recessed in a lip cast around the cover, flows to the bottom and finds its way back into the engine through holes drilled into the casing.

In addition to this large cover the engine is liberally provided with hand holes wherever needed.

In the base of the engine will be seen the pipes of the cold-water service which

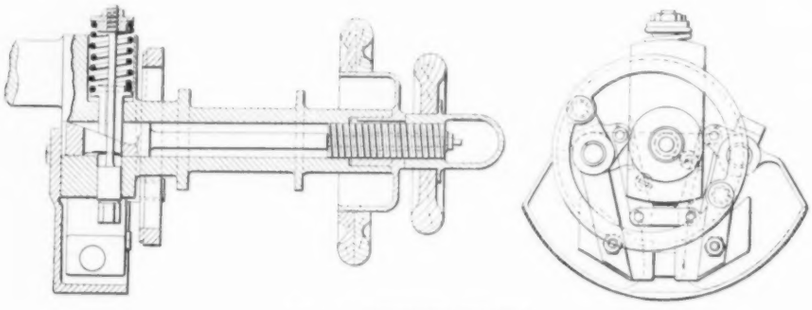


FIG. 4. GOVERNOR DETAILS

are called into play if the engine shows any tendency to heat.

Though the shaft turns outward in running, throwing most of the lubricant against the guides and baffle plate, yet some splashes get past and, striking the low-pressure cylinder, are heated and fall into the rest of the oil. In later engines this has been carefully baffled against. In some of the earlier ones it has been found desirable to install the cooling system largely to guard against this feature.

The Governor

The valve feature is unique. Reference to Fig. 4 will show that a single eccentric is held free from the shaft by means of two trunnion pins, which are mounted upon levers free to swing about axes that are fixed in their relationship to the crank-shaft, and are mounted in a casting fastened to it. These levers, which are steel forgings, have the governor weights fastened to their outer ends and are controlled through two links and a single tension rod by one coil spring of great power set in the end crank-web which is made specially wide and bored out to receive it. The levers are so mounted that centrifugal movement of one weight shortens the lead of valve, while a similar movement of the other weight decreases the throw of the eccentric; the two actions take place simultaneously.

It will be seen that the thrust of the governor spring is taken by a steel collar which in turn rests upon a steel wedge in the interior of the bored-out crank-shaft. The latter has a round stem which passes through the interior of the shaft and at its outer end is fitted with a sleeve, so attached that while quite free to revolve on the stem it cannot move in either direction without taking the stem with it. This sleeve has a square thread turned on it and a sliding keyway. Upon the sleeve are mounted two hand-wheels; the inner one feathered and free to slide on the top of the threads, the outer one with a thread cut to fit that on the sleeve. When in place, with governor gear set up, the feathered hand-wheel takes its thrust against the end of the shaft and the other wheel thrusts against its fellow; the pressure of the spring on face of wedge holds them to their work. When the engine is running the action of the governor can be modified by grasping the inner of these two wheels with one hand and turning the other to right or left, thereby putting greater or less compression on the spring. One object of this device is to maintain a constant output of electric current under all conditions, as there is a tendency on the part of the dynamo to change in efficiency as it heats up. Thus suppose an engine is driving a dynamo at 500 revolutions per minute. At the start of the run there would be a normal output of energy, but in the course of an hour's time heating of the coils would take place with a resulting loss in efficiency to the extent of perhaps 3 per cent.; thus an increase in the speed of engine of 15 revolutions per minute would bring things back to normal.

This hand regulation serves another useful purpose. In stations where the current is used for lighting a city the "peak of the load" occurs in the late afternoon and is especially heavy during the winter months. It usually reaches its highest point about 5 o'clock, at the time

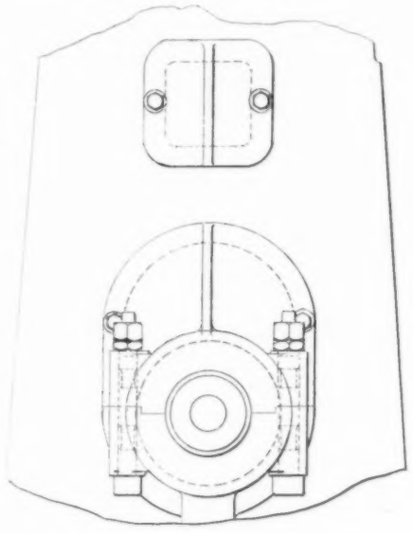


FIG. 5. DETAILS OF BEARING CAP

when store and shop and street lights are all going together, and just before the offices of professional men close. Thus for a period of perhaps 15 or 20 minutes the engineer in charge is often at his wits' end, should he be short of power. The hand adjustment of the Sisson engine is a friend in need at such times; a turn of the wheel gives the 5 per cent. or 10 per cent. extra power that is needed.

The eccentric strap and rod is a two-piece casting of phosphor bronze as shown in Fig. 7. There again we see the characteristic opening at the sides. The eccentric connects with the valve spindle through the medium of rockshaft and levers. It will be noted that the eccentric is inclined away from the center line of engine at the top. This allows of modifications in setting the valves, by moving the pillow-blocks of the rockshaft back or forth as desired, before finally bolting them to the brackets.

The link connecting the rockshaft with the valve spindle is fitted with sliding blocks of phosphor bronze and a hardened steel wedge with a spring, to be self-adjusting as in the case of the connecting-rod brasses. On the lower end of the valve-spindle is a cushioning cylinder and piston, taking air through holes drilled in its sides. The object of this device is to absorb the shock as the valve parts are brought to rest at the end of each rapid stroke.

The Valves

The valves are both of the piston type,

made of hard, close-grained cast iron and are a floating fit upon the valve-spindle. The low-pressure valve in the smaller sizes of engine is like the high-pressure, fitted without rings, but is made a good sliding fit in its liner. These liners are of nickel cast iron, which gives admirable results; owing to its greasy nature it resists corrosion remarkably well, and in process of running takes a very smooth surface without perceptible wear. In fact, with proper care as to cylinder and valve lubrication, one of these valves will still show the tool marks after running for years, bearing striking testimony to the alinement of parts and also showing that the valve is truly balanced.

The valve liners are made a driving fit to their seats and are drawn into place by a nut and bolt. They are first well coated outside with red lead and oil. The high-pressure liner is made in one piece, the port edges are filed to correct dimensions before they are placed in the cylinder casting. The low-pressure liner is in two pieces.

The diameter of these valves usually bears a ratio to the diameter of the cylinder for which they are intended of about 1 to 0.38. The width of the steam-ports measured vertically is about 0.14 of the diameter of the high-pressure cylinder.

Gun-metal relief valves are shown covering the "sighting" holes; these valves are absolutely necessary in piston-valve engines to take care of any water which may find its way into the ports. The high-pressure valve has inside steam admission; in order to avoid crossing of the ports, or a double eccentric system, the low-pressure valve has outside admission.

This arrangement works out well in another way, as it causes the low-pressure ports to be short and straight, thus avoiding some waste through the larger clearances of long ports. The small guide chamber at the top end of the valve-spindle is tapped for a grease cup to lubricate that part.

At the end of a long run the lubricating fluid is drawn off through the cock shown at the rear of engine; when ready to start again water is run into the lower part of the crank case until the bottoms of the crank-webs are just submerged when in their vertical position. On top of this water a layer of machine oil is poured to a depth of 3 to 4 inches. Under the tremendous churning effect of the cranks this soon forms a sort of emulsion which quickly finds its way to every part of the engine that it can possibly reach.

It may be of interest to give some consideration to the theoretical side of the Sisson engine design.

The Main Shaft

We will turn our attention to the shaft feature. An endeavor is made to balance the reciprocating weights in the two cylinders. This can be easily accomplished by utilizing the extra length of the high-pressure piston-rod to fill in the difference between the weights of the two pistons. Then each of the two outer crank-webs is counterbalanced, as shown by the governor gear at the high-pressure end and by a cast-iron balance weight at the low-pressure end.

It is true that the various weights on the shaft are balanced correctly in the direction of revolution, but we have a slight rocking movement in the plane of the center line of the engine, due to the space between the piston-rod centers. As this space in most Sisson engines bears

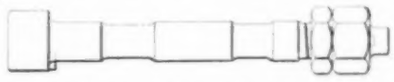


FIG. 6. DETAILS OF BEARING CAP BOLT

a relation, when compared to the distance between centers of the main bearings, of about 1 to 4½, it is obvious that the opposed rocking forces must be divided by 4½ to find their ultimate effect upon the engine as a whole, as applied to it through the main bearings. In a single-cylinder engine this reciprocating movement is entirely unbalanced, thus it will be seen readily that taking two engines of the same dimensions, the Sisson type will have an advantage of 4½ to 1 in lessened vibration

In the case of a side-by-side compound with cranks at 90 degrees, the advantage would be about the same in favor of the Sisson engine. What this means in reducing size of foundations, in lessening

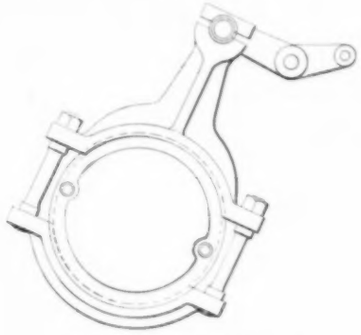


FIG. 7. ECCENTRIC STRAP

wear and tear on bearings, in freedom on the part of the construction engineer to place the engine in any part of any building where the floor will carry the weight, irrespective of whether the building is filled with offices or not, can scarcely be overestimated. I have seen a test, not upon a heavy concrete bed, but upon a lightly bolted down cast-iron plate. The engine was a 6x10x6-inch running at 550 revolutions per minute. So quietly and smoothly did it run that an English half-penny, a copper coin 1 inch in diameter, was balanced, without a tremor, on the low-pressure cylinder cover.

At the Bankside electric light and power station, in London, an engine of this type, 15x24x15 inches, was selected to drive the large fan furnishing induced draft to 35 Babcock & Wilcox boilers with an output of 40,000 horsepower. The conditions were unusual; the fan was so mounted that any direct-connected engine would have to be set upon steel beams resting in the wall of the building. Only one engine was on the market whose designer and builder had faith enough in his product to stand by and see an engine of 500 horsepower so mounted, without fear of its shaking the building down. The Bankside engine has been running happily for 10 years past. Not only has it maintained its record for silent running, but also for steadiness, a matter of equal importance as a shut-down means the putting out of commission of a large part of the 40,000 horsepower in the station.

A point which engines of the high-speed type have in common with the steam turbine is regularity in running. Comparing a Sisson engine of, say, 60 horsepower indicated, running at 550 revolutions per minute, with a cross-compound engine of the same power, but at 150 revolutions per minute, an irregularity to the extent of 3 per cent. on the part of the high-speed engine means 16½ revolutions per minute one way or the other; similarly in the slow-speed engine 3 per cent. means 4½ revolutions per minute. As in each engine there are four steam impulses to a revolution, it follows that while the slower engine is endeavoring to correct the fault with a margin of 18 impulses, the other engine has a margin of 66 impulses, or a ratio of 11 to 3 in its favor. In other words, it should correct a fault of this kind with one-fourth the error of the slower engine.

American Machinist readers will no doubt be interested in a consideration of the mathematical phase of the design of these engines. It was manifest from the start that the ordinary formulas for crank-shaft design would not serve. So standard practice was cast to the winds and instead of placing the main bearings as close to the line of thrust as possible it was desirable to separate them widely. This made it necessary to design a crank-shaft of unusual rigidity (this was also necessitated by another reason given later on) and this fact permitted bearings of exceptional size. The large proportion of journals and crank-pins combined with the quality of the gun steel used in its make-up, cause me to think that, for the size of engine, it is one of the strongest crank-shafts made. It is manifest that the main bearings should be so proportioned that a film of the oil and water mixture could always be maintained between brass and steel. It has given thorough satisfaction to allow these bearings such a projected area so that the maximum load is about 150 pounds per square inch,

with a journal speed of 360 feet per minute. This is with the unuseful portion of the bearing cut away, so that the area of contact top and bottom should subtend an angle of about 120 degrees, as shown in the small section. In order not to exceed this pressure the lower brass of the flywheel-end bearing is extended in each direction, making its length about three times the diameter of the shaft. The upper half of this bearing has little to do, as the lift of the low-pressure piston is off-set by the weight of the flywheel

Coming now to the crank-pin brasses we find a new element to contend with, for not only are the loads much greater, but there is also a constant pressure on each brass due to the self-adjusting mechanism. Let us consider for a moment what this amounts to independently of the load due to steam. In the 9x15x8-inch type of engine the size of the crank-pin is 4¾x7½ inches on its bearing surface, giving a projected bearing surface on the brass of 30 square inches. Now the wedge used to keep the brass against the crank-pin, as already pointed out, has a taper of 1 in 4. The spring controlling the wedge in this case exerts a pull of about 4000 pounds, creating a load on the brass of about 8000 pounds, allowing an efficiency for the wedge of 50 per cent. This load gives a pressure on the brasses of about 275 pounds per square inch. Such an engine as this works at a boiler pressure of about 120 pounds, so that when the thrust of the steam is added to that of the wedge the load reaches 600 pounds per square inch. Hence an additional reason for large crank-pins.

The maximum load on the gudgeon reaches a total of close to 18,000 pounds. Although this pressure, which is equivalent in the case of the 9x15x8-inch engine to about 1800 pounds per square inch, is incurred during the up stroke only; on the down stroke we have a pressure that is about half of this. These engines will carry their load with surprising regularity; a variation of more than 1 per cent. in speed is quite exceptional, even in cases where the load is whipping back and forth within wide limits.

An Unusual Planer Rig

By Harold N. Harrigan

This is the story of a planer that was made to do double duty. Queer stunts sometimes have to be done with machines to save time or labor, but to make a planer work both ways may be new to someone; this short article tells how it was done in a case where it was necessary to do so. The illustrations show the rig. There were 32 cast-iron rings 7 feet 4 inches by 6 inches face to be split. These rings were removable treads on the running rings of special sugar dryers built by the Hersey Manufacturing Company, of South Boston, Mass., and required to be bolted in halves over the dryer drum. They were cast in a complete circle, but with 1 inch between the bolting lugs to be cut out.

The job was done on a 40-inch Flather planer in the following manner: The rings were strapped to the platen in the usual way, and one tool was rigged in a tool holder on the cross-rail. The other saddle was taken off and bolted to a 30x15-inch angle iron, which, in turn, was

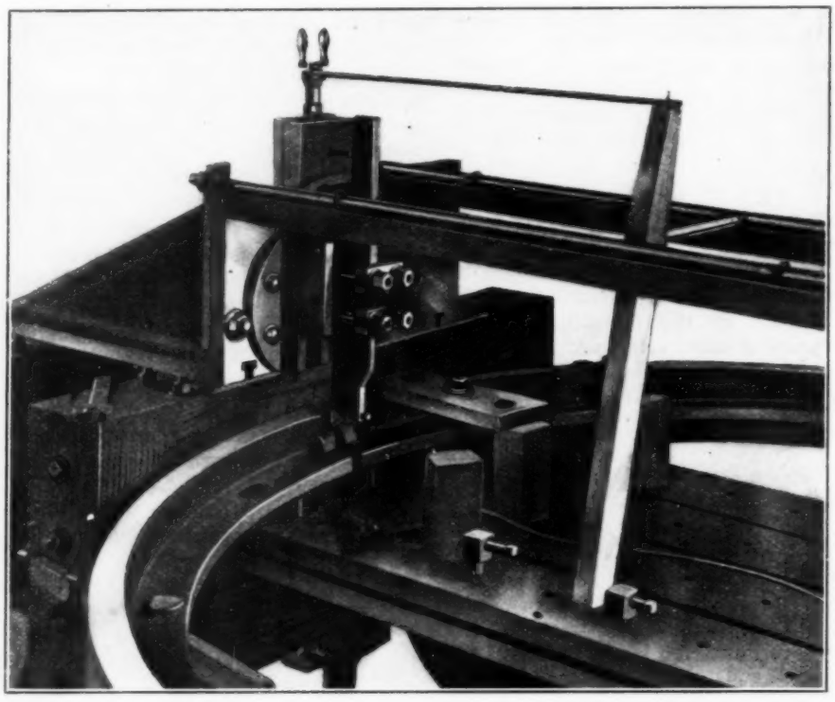


FIG. 2. DETAILS OF SUPPORT FOR SECOND TOOL AND ITS FEED

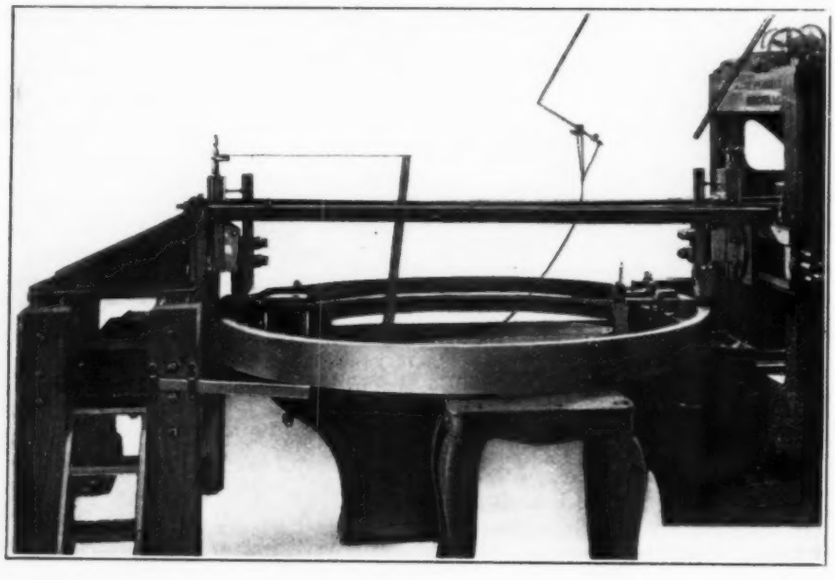


FIG. 1. A PLANER RIGGED TO CUT ON BOTH STROKES

bolted to a heavy wooden frame erected on the floor at the foot of the planer. The part of the platen which overhung the bed was supported by babbitted ways cast in the wooden frame; the angle iron was also tied securely to the cross-rail. This was done to prevent the angle iron, etc., from lifting when the return cut was on. As a result the tool on the cross-rail cut on one stroke, and the tool at the foot of the planer cut on the reverse.

The feed for this second tool was obtained by a simple lever and strap hung on the stay rods and operated by blocks on the platen. This transmitted motion to a ratchet. This device was made easily removable when the work was removed and replaced. Two cuts were made on each ring; the tools were small and were held in special holders; the first cut was 11/16 inch and the finishing 1 inch. A little over an hour was required for each cut and the whole device was found to work satisfactorily.

Modern Methods of Making Steel Pens

The Latest Development of a Little Known Industry Which Dates back Many Hundred Years as Shown by the C. Howard Hunt Plant

EDITORIAL CORRESPONDENCE

Most of us have an idea that the making of pens from metal is of very recent origin as our fathers have told us how they made their writing pens from quills, in the not so very distant days when they went to school. But they date back farther than we realize, the earliest record being among the ruins of the city of Pompeii, and, as the celebrated eruption of Vesuvius put them out of commission in 79 A.D., the date of origin must go way back of that because both bronze and silver pens were found in the ruins. These can be seen in both the British museum, and the museum at Naples.

The first steel pens were naturally copies of the quill, the pen and holder being all in one piece, but on account of the cost of throwing away the holder whenever a pen wore out, the pen or nib was made separate and the barrel part fastened itself naturally to the pen holder as we have it today.

As with all new inventions and processes the early products were crude, the pens were stiff and unyielding and far inferior to the quill in flexibility and ease of writing. But this has been overcome gradually and pens can now be had with any degree of flexibility, this being secured by the introduction of side slits of various sizes and shapes.

The slow growth of the industry can be judged by the fact that as early as 1825 such machines as screw presses began to be introduced into the business, and yet the pens were practically unknown to our fathers long after this, and in fact the United States army was supplied with quill pens all through the Civil war.

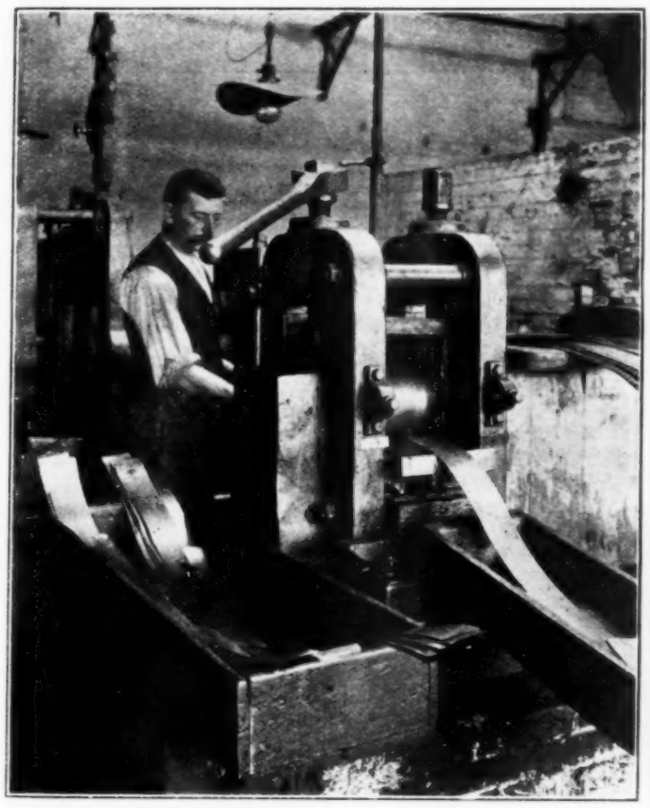


FIG. 1. THE ROLLING MILL

FIG. 2. AUTOMATIC CUTTING MACHINE

Coming to the modern way of making steel pens, we have been favored by the C. Howard Hunt Pen Company, of Camden, N. J., to the extent of a careful inspection of their plant and the securing of the illustrations which are used herewith.

The Steel Used

The steel used in their best pens is imported from England, being made specially for this purpose. It comes in sheets 0.023 inch thick and is cut up into strips 2½ inches wide. They are then annealed in cast-iron boxes and after removal are placed under a large hood which keeps the air from the boxes while they are cooling down. When cool they are pickled in dilute sulphuric acid to remove the scale and then are ready to go to the rolling mills to be reduced to the exact thickness required for the different styles of pens which vary from 0.004 to 0.014 inch in thickness. The rolling is done cold and has to be handled very carefully, the strips being lubricated enough to make them roll uniformly. One rather peculiar detail is the fact that although the strips do not run between guides, the increase in dimension is practically all lengthwise, as the width does not gain more than 1/32 inch while they lengthen out to 50 or more inches. The sheets are all rolled to snap gages and are made very uniform, indeed, before they go to the punching operation. The rolls are shown in Fig. 1.

The nicer pens are cut by hand, as shown in Fig. 3, in a press with a very rapid multiple-thread screw operated by the bent handle. This forces the blanking die through the steel, the strips being cut showing the first series and the waste at the left giving an idea of how closely the stock is used up. A good operator will cut about 45,000 blanks per day. This waste all goes back to the mills.

The lower grades of pens are made from steel which is bought in long strips

FIG. 3. CUTTING PEN BLANKS BY HAND

FIG. 4. THE PIERCING OPERATION

or rolls and are fed through a regular Ferracute crank press, as in Fig. 2, blanking out two pens at each stroke. The steel bought in this way is not as uniform in thickness as that which they roll themselves, so that it is impossible to know just the spring of every pen as is necessary in the higher grades. This seems like a hair-splitting point to those who only look at the manufacturing end, but regular pen users are among the fussiest individuals we know of and the "feel" and action must be just right to give satisfaction.

The next operation is piercing and side-cutting as shown in Fig. 4. The same kind of a press is used and an idea of the punches and dies can be had from a close inspection of the machine. This requires very nice die work, especially in the slitting, as the blanks must not be distorted by any of the operations. The pens are fed into the press, against a stop and the operators acquire great dexterity as in all operations of this kind. The side-cutting sometimes requires two or even three operations as it is very peculiar on some pens and after this operation the pens are annealed, being heated in large iron pots and cooled slowly as before.

In Fig. 5 we have a lot of light drop hammers, operated by foot power, for marking or stamping the name or imprint on the blank. This operation is very similar to the forging of small knife blades although the work is much lighter in every way and the hammers rise and fall with remarkable regularity. The stamp is shown in the bottom of the hammer and moves with it. Some pens are embossed with letters or figures, which is an extra operation.

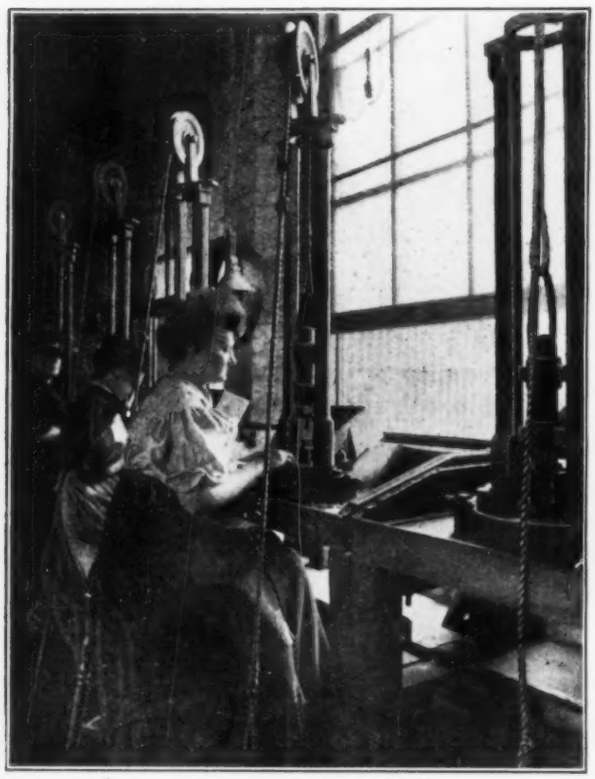


FIG. 5. MAKING THE IMPRINT ON PEN

FIG. 6. RAISING OR CURVING THE PENS

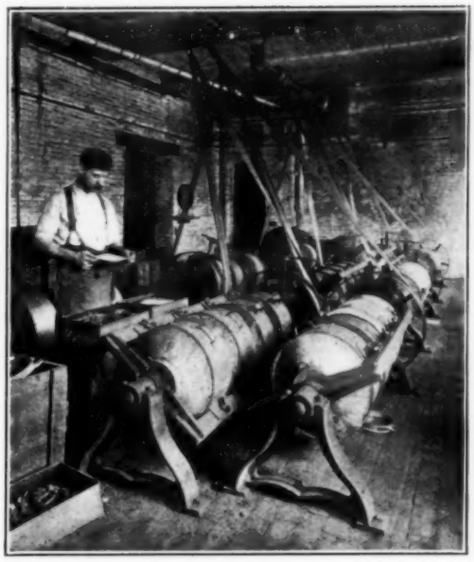


FIG. 7. SCOURING ROOM

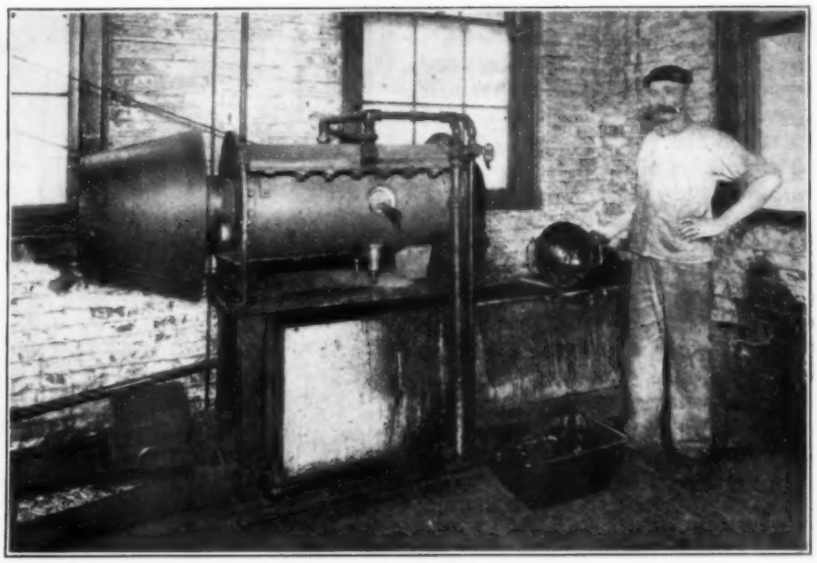


FIG. 8. HARDENING AND TEMPERING

USING AN AIR JET

Up to this point the pens have remained flat, the next operation is curving or raising as the penmaker calls it. This is also done in a screw press but with balls on the handle to give it weight and add to the momentum.

After being raised they have a tendency to stick in the lower die and it was formerly necessary to push them out with a little rod of some kind or with the fingers. It sometimes happened that the ram came down before the fingers got out of the way and to prevent the possibility of accidents each press is now equipped with an air jet as shown. The die is made so that the air jet strikes under the back end of the pen and as soon as the ram is raised, the pen goes sailing out of the die into the pile at the back. This saves fingers and also increases the output of the press.

After this raising operation the pens go to the inspection room to be examined for defects in any of the operations that have already been done. The piercing, for example, is a very particular operation, and it requires only a small variation to either side of the center to spoil the pen as the slitting which follows cannot be done properly and the points of the pen will not have the same action.

The inspection over, the pens go to be hardened, for they are soft up to this point. This is done in the machine of the American Gas Furnace Company, shown in Fig. 8, where, after heating, they are cooled in oil. The pan with the V-shaped opening and the round end, shown on the floor at the left of the machine, shows how conveniently the pens may be handled. They can easily be dumped into the large opening and then, by tipping, can be slid into the furnace through the round end. From here they go into a centrifugal separator which throws off the surplus oil and a bath of boiling lye removes all traces that may be left. After this they are dried in sawdust. They are then reheated to secure the proper temper, which must be very tough and flexible.

UNIQUE TUMBLING MACHINERY

This leaves them coated with a film of oxide which is removed by tumbling in the machines shown in Fig. 7. These consist of frames which hold four cans each, made of heavy sheet iron and somewhat resembling milk cans, which are large in diameter but much shorter than the usual proportions. The cans have a cone top so that the contents can be easily dumped, and they are made as smooth as possible inside to prevent pens catching in crevices, or being bent out of shape by projections.

They have tops similar to milk cans also, but have a heavy lug on each side

FIG. 9. THE CROSS-GRINDING MACHINE

FIG. 10. SLITTING THE TEMPERED PENS

by which they are fastened to the frames with the large thumb or hand nuts, as shown. This arrangement is very handy for work of this kind, and here the oxide is scoured off by the action of crushed quartz and flint.

The grinding of the pens was formerly done entirely by hand, and some is still done in this way. Most good pens are ground both lengthwise and crosswise of the pierced hole, while some have even a third grinding. The lengthwise grinding is usually done by hand, the girl holding the pen over the grinding wheel with a pair of pliers, and in spite of its seeming slowness, a large number of pens are ground in a day in this way.

The crosswise grinding is also done by hand in some places, but a very neat machine is in use in this plant, as shown in Fig. 9. The wheel beneath the girl's hand has a number of places for pens which she places in the holders, and as the wheel turns they are clamped while the pen passes under the grinding belts or strip shown and are released when ground, so that it falls into the chute shown and slides into a box beneath. This makes a more uniform grinding than hand work, and gives a better appearance to the pen.

The object of the grinding is to add to the resiliency of the points and also to assist in holding the ink while writing.

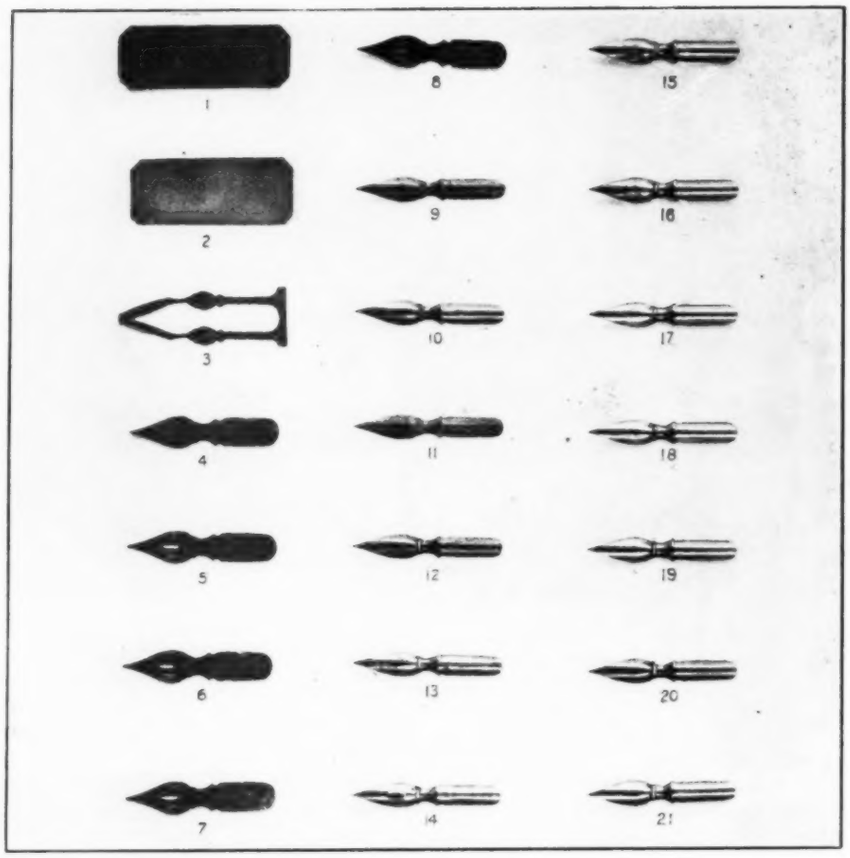


FIG. 13. VARIOUS OPERATIONS ON THE HUNT NO. 700 PEN

1 Raw steel
2 Cold-rolled steel
3 Scrap steel
4 Pen blank
5 First piercing
6 Second Piercing
7 Annealing
8 Marking
9 Raising
10 First examination
11 Hardening
12 Tempering
13 Scouring
14 Cross grinding
15 Straight grinding
16 Slitting
17 Rounding points
18 Second examination
19 Polished
20 Colored
21 Lacquered and finished

Slitting the Points

In the old days of steel-pen making in England, the points were slit before hardening, and the expert penmaker had to peen them back into position to make a good pen. This was a ticklish job, and was one of the main points that made steel pens so expensive at that time, when they cost from 25 to 50 cents each.

Rumor has it that this was how Gillott, of England, secured his start in the pen business. Everything was as secret as the grave, but he secured a job in the pen shop, learned how to peen the pen points to perfection, conceived the idea of hardening them before slitting, and, incidentally made love to and married his employer's daughter so that he became a

FIG. 11. THE FINAL INSPECTION

FIG. 12. COUNTING AND BOXING

partner in the business. He is also credited with having been one of the first to open his doors to visitors, knowing from his own experience that it was almost impossible to keep everything secret even if he wanted to.

Whether this be true or not, pens are now hardened before slitting, and the slitting operation is shown in Fig. 10. As can be imagined, this calls for nice dies, and a nice adjustment of the press, for the points must not be distorted during the cutting and must not be bent enough during the cut to give them a permanent set. They are put in against a suitable stop and can be handled very rapidly by an experienced operator. This slitting must be done exactly in the center of the point and run to the center of the pierced hole, which requires very accurate setting of the guides.

The Hunt company makes a ball-point pen in which the points are struck in another press after slitting, so as to turn the points up a trifle and give the action of a ball on the end of the points. This is simply a nice piece of die work in which everything must be just right in every way.

It is now necessary to tumble the pens; this operation is sometimes extended to days, the pens being tested for smoothness of points, and if not all that the inspector thinks desirable they go back for additional tumbling.

Final Inspection

Every pen is examined, as shown in Fig. 11, by being laid on a sheet of black glass so that any imperfection is readily detected. The trained eye sees anything that is not right at a glance and the poor pen goes into one of a number of boxes, according to the defect. This enables the poor work to be charged back to the proper department, but it is rather surprising to find the small percentage of waste that is found in this way. This plant does not turn out any seconds, but all waste is immediately heated so as to be useless for pens and goes in with the scrap material.

Polishing and Lacquering

The pens are now ready for the final polishing and smoothing which is done in the same tumbling barrels as shown in Fig. 7.

This leaves them bright and some are lacquered and left this color. Others are made bronze, blue or black by heating in a revolving furnace and cooled quickly to retain the color. They are then lacquered to prevent rust.

While the counting and boxing is hardly a mechanical operation it is extremely interesting to see how dextrous an operator will become in such work. The pens are, of course, counted by weight, as shown in Fig. 12, a counted gross being put in one pan of the scale and then the rest weighed to balance this in the other pan. The gross of pens are dumped in one of the half-round trays, are picked up by the girl at the left and, quicker than it takes to write it, she has jiggled them down into one end, in an even bunch, and rolls them into the box with one twist of the wrist and they are practically ready for the market.

The steel-pen industry is still growing in spite of the fountain pen and the typewriter, and it is estimated that from 10,000,000 to 13,000,000 gross are produced each year in all the pen factories of the world. Of this the United States makes probably 2,600,000 gross annually.

Fig. 13 gives a graphical illustration of the various operations on the Hunt No. 700 pen, which is their specialty. We are indebted to L. A. Hawkes, the general manager, and his able assistants for the information secured.

F. H. C.

Some Vicissitudes of the Job Shop

By J. G. Dornbirer

Business being very dull, one of the boys who had just completed his apprenticeship decided to see how things were going in some of the other shops within a radius of about 25 miles. He visited an old mining town where he found a machine shop of considerable size and quite busy. He may have exaggerated things a little bit when he related this story, but he affirmed that every word was the truth.

When he inquired for the man who did the hiring he was sent down stairs to the basement where a little old man took care of an engine and boiler and a girl was cutting staybolts on a bolt cutter. The old man sized him up and took his measurements around the waist and hips and then carefully compared them with the manhole and fire door on an old boiler out in the yard; explaining that the boss had hired men regardless of size, and since they had a great many boilers of that kind, they thought it wise to get men who could get into them if necessary. The old man then sent him over to the girl where he had to stand an examination on boiler repairing; having served his apprenticeship under an old hustler and in a job shop, he was able to satisfy these parties who gave him a ticket, just like you get in a restaurant registering the amount of hash consumed, and directed him to the office.

In the office he was told that they were looking for two all-round men, and if he came up to the requirements the job was his. The proprietor was a sort of an old sissy, who inherited the business without the mechanical ability of his predecessor. He began by telling him that they had no regular patternmaker; that if he would come upstairs he would show him some of the work done by their machinists in case of a pinch. The exhibit was very poor; in fact the boss in the foundry, where they went next, said that frequently he had to burn them out of the mold. This young man had never made a pattern, but felt that he could do as well as had been done in that shop, and assured the proprietor that he could do the work. He was then taken to the foundry and left there with the foreman for about a half hour. All about him he saw pulleys, truck wheels and sundry castings with spokes and rims cracked, full of blow holes and various defects. The young man inquired as to the cause of the trouble, and all the answer he could get was that the patterns were not of the right proportion. One wheel about 20 inches in diameter, of which they used quite a number, was for a truck used in a warehouse, and as he said, "was the poorest proportioned thing he had ever seen."

"Now look at that blasted rim; every one of them will have to go to the blacksmith shop to have a band shrunk on them." The young man ventured to ask where the iron was kept for melting, and was told that it was kept in the yard where the present owner's father used to keep the pig iron, and that he would presently show him their stock of iron. After cautiously inquiring whether he had ever helped pour iron, lift a cope and turn over a flask, and was answered in the affirmative, they went to the scrap yard where he saw quite a pile of scrap, but no pig iron. The boss explained that he had very good success with their iron mixture since they had large quantities of heavy machinery scrap.

He then gave the boy another ticket and sent him to the blacksmith shop; here, after a few minutes' talk, he got another ticket with which he proceeded to the office, where he was met by the proprietor with the remark that the machine-shop foreman had just come in and he would give him a day's trial in the machine shop in the morning. On the following morning he came quite a little ahead of the time to begin, walked around to size up the equipment, and noticed the gear wheel on the planer, which was used for a pattern to make the above mentioned truck wheel.

This young man was very bold, and called the foundry boss and showed him the gear, then rolled up one of the truck wheels with the remark that no iron band had been shrunk on the one on the planer; the boss told him it was a steel casting, but a crack in the hub where the key was pounded in until it looked like a broom made him back down. When the proprietor heard of it, it set him to thinking.

Presently the boy was put on a small pulley lathe and soon discovered that the carbon-steel tools in use at that shop would make an all-day job of two pulleys; he had, however, a mushet-steel tool which was far ahead of carbon steel for that job. The foreman and some of the other men told him that two or three pulleys was a day's work.

This mushet-steel tool looked very much like the ones used on the lathe. The boss started the job for him, showing him the way that their experience proved the best, then after turning about an inch himself, he left with the remark that he would be back presently; he came back in about an hour and a half and found the pulley turned. His eyes stuck out far enough to have been knocked off with a stick. He called the proprietor and showed him what nice castings they were getting. By this time the boy had another in the lathe; the foreman tried it with the carbon-steel tool and could do no better than on the first pulley; then walked off with the remark that it might have been softer than this one. The proprietor, however, stood there and the boy ground up his mushet-steel tool and went over the pulley the same as with the first.

Never noticing that the tools were exchanged, the proprietor got to thinking some more. To make a long story short, the foreman at the end of the week exchanged places with the boy, and the foundry foreman got the G. B. Some may think that the boy took an unfair advantage of the boss, but the boss had a right to read up and notice what was being advertised, and surely was in a position to apply the knowledge thus obtained.

Magnetic Chucks for Small Work

By O. S. Walker*

The accompanying illustrations show an interesting job of grinding on magnetic chucks, which should be of general interest. It is not generally known that the pieces most difficult to hold on magnetic chucks are those of extremely small cross-section, when there is insufficient metal to magnetize, and we have heretofore been obliged to turn down considerable business on account of the seeming impossibility of holding these small parts, and this is especially true as regards the parts entering into the construction of watches.

The piece of work *A* and *B*, shown in Fig. 5, illustrates a watch hair-spring lever and a small washer of the dimensions given. These parts we have recently succeeded in holding successfully by means of a special small chuck with fine teeth milled from solid steel.

Figs. 1 and 2 show the special chuck. Fig. 3 shows it with the back rest 3 and end stop 5 removed, and the alining strip 4 thinned down to a little less than the thickness of the work. It also shows the arrangement for grinding hair-spring levers. Fig. 4* shows the same chuck as Fig. 3, but arranged for holding the small washers. Fig. 5 illustrates the work, and the special fixtures for holding it.

Referring to Figs. 3 and 5, 9 and 10 are simply strips of tin a little less than the thickness of the work. One end of each piece has a projection at right angles to form a stop for the work, and the method of packing the work is plainly shown in Fig. 3, from which it will be noted that one piece of work assists in locking the adjacent piece, the levers being slipped onto the chuck from the left-hand end between the strips of tin. It will be seen that it is possible to grind 44 of these levers at one setting, the thrust of the grinding wheel being toward the end stop.

For grinding the small washers, the method is plainly shown in Figs. 4 and 5, 12 indicating the parallel strips of tin of about the same thickness as the washers, each piece being perforated with 108 holes, to allow the washer to slip through easily. These holes must be spaced longitudinally, so that the washers in each case lap over the narrow magnetic gap between the poles. This gap being 1/16 inch wide, gives 3/64 inch on each side, the magnetic lines flowing through the work over the gap, thus obtaining a holding force. The magnetic power also tends to hold down the tin, and the combined holding force of the large number of washers and the tin itself secures the work very firmly. The washers, however, have a tendency to rotate, but by the use of the proper wheel we had no trouble in grinding them successfully. As can be seen from Fig. 4, it is possible to hold something over 200 washers at one setting on one of these chucks.

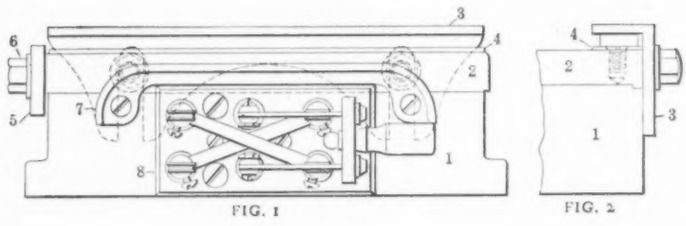


FIG. 1

FIG. 2

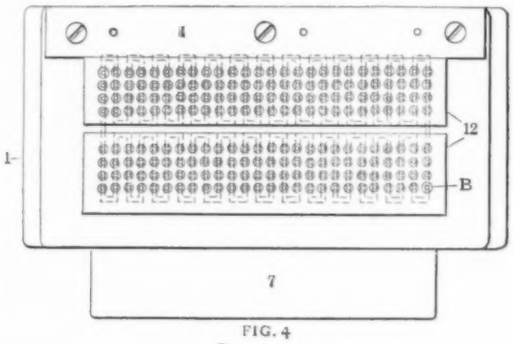


FIG. 4

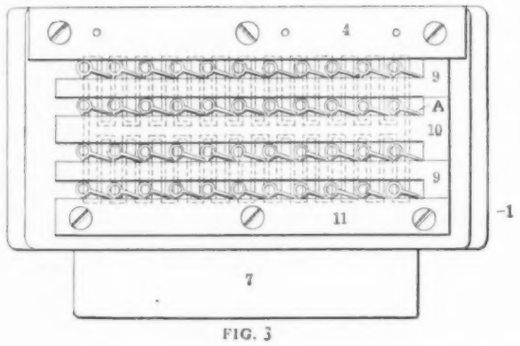


FIG. 3

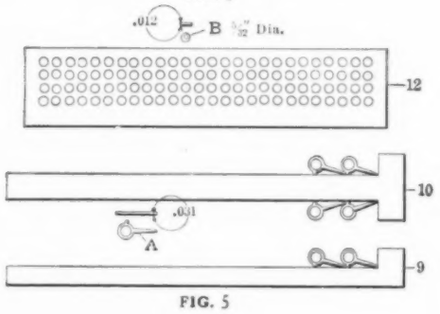


FIG. 5

USING MAGNETIC CHUCKS FOR SMALL WORK

*O. S. Walker & Co., Worcester, Mass.

If a man works for a living—that's all he gets. The fellow who reaps the prizes is the fellow who enjoys his work and is sorry when it's time to quit.

Practical Letters From Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Saving Material in Turret Lathe Work

A firm wanted ball bearings made of high-carbon steel. This was a case when the cost of materials counted. At the start they worked out the outer races R_1 and inner races R_2, Fig. 1, on two different turret lathes from steel bars. The idea struck me, to save the material wasted in boring the outer racks.

The idea was to make the outer and inner races from the same steel bar. The bore L and the ring C were finished by one operation. After that we cut off the outer race, as it is shown in Fig. 2. The inner race R_2 was finished in the turret lathe with the same chucking, while the groove in the outer race was made on another machine.

When the dimensions of c were large enough, it was possible to finish the grooves of the outer race with the first chucking also. The same principle was used in making the thrust-bearing plates shown in Fig. 4. The same tool could work out the grooves for two or more sizes of bearing plates g_1 and g_2, in Fig. 5.

When the work was done the bearings were cut off on the line M. If the hights of the plates were different it was made by cutting the grooves g_1 and g_2, one below the other. Another interesting way of saving materials by means of some special arrangement in the machine is shown in Fig. 6.

Rochester, N. Y. E. MEITNER.

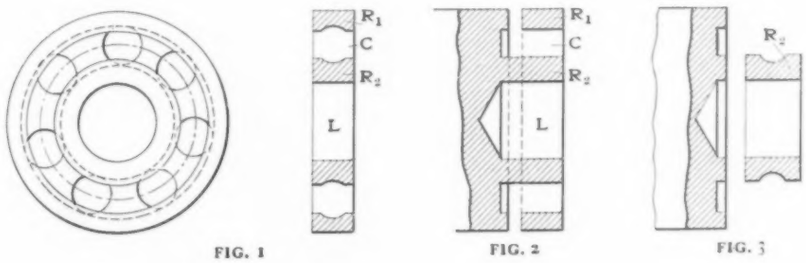


FIG. 1

FIG. 2

FIG. 3

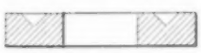


FIG. 4

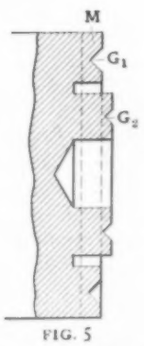


FIG. 5

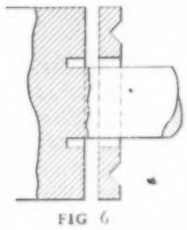


FIG. 6

SAVING MATERIAL IN TURRET LATHE WORK

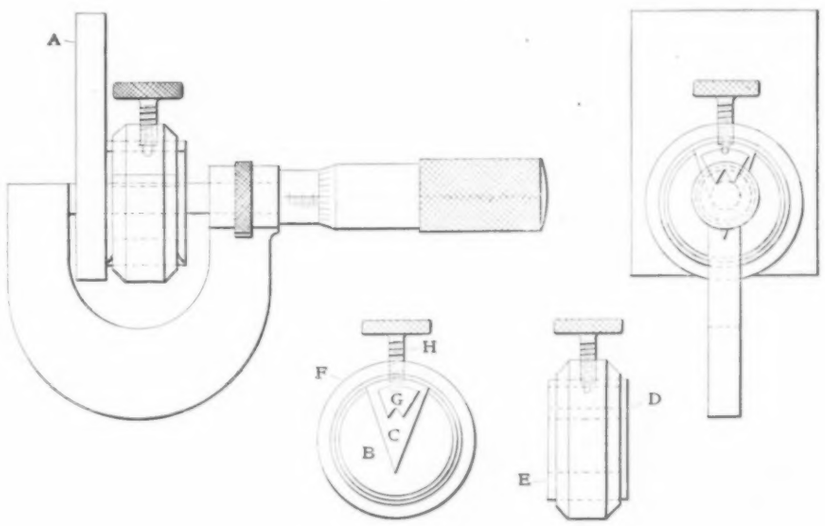
Lapping Device for Micrometers

This lapping device is very simple and easily constructed, and has proved itself invaluable for refacing both the anvil and the spindle ends of any make of micrometer. It has been tried on a number of different makes and has worked very satisfactorily on all, in each case bringing the two faces parallel to each other.

The plate A is cast iron with the sides ground parallel. B is a V-block hardened, and with angle C ground out, and sides D and E ground parallel on a true arbor after collar F is shrunk on. G is a loose shoe hardened and ground, and set up by screws H for clamping B to the spindle of the micrometer.

To lap the anvil, clamp the device as shown to the micrometer spindle so that the end of the spindle will not touch plate A when screwed up, but so that plate A just binds between the anvil face and the ground face of block B. Then charge a small spot on plate A with oil and carborundum and slide the plate back and forth past the face of the anvil, using care to keep the micrometer spindle screwed up just tight enough so that the plate will slide freely between the faces.

To reface the spindle, remove the device from the spindle and remove the latter from the micrometer barrel; lay plate A on the table, and place the lapping device on the spindle with the binding screw just tight enough to hold it in place. Then off on another place on the plate press the device down squarely on the spindle so that the spindle face just touches the charged spot on the plate and the ground surface on the block B rests squarely on the plate. With the thumb pressing down firmly on the micrometer thimble tighten up binding screw H, then place the end of the micrometer spindle over the charged spot and with the thumb



MICROMETER LAPPING DEVICE

pressing down on the top of the thimble and holding the face of block *B* squarely against plate *A*, proceed to lap as before till true. When true, remove the device, clean the faces thoroughly, place the spindle of the micrometer back in the barrel and then adjust the anvil till the graduations on thimble and barrel read at zero when the anvil and spindle are in contact.

Newburg, N. Y. A. C. K.

A Tool-holder Kink

One of our apprentice boys had about 100 bushings to make of soft steel, about 1⅝ inches diameter by 1¼ inches long and threaded for about ⅝ inch on one end with a 20-thread. They came to him drilled and reamed and he was to put them on an arbor, turn them, and chase the thread.

After he had turned out a half dozen he began to look worried as he usually does when he has an idea. Finally, he ground up three tools for the straight Armstrong tool holder, one for turning, one for threading and one for trimming

TOOL HOLDER WITH STOP PIN

and rounding the ends of the bushings. Then he took the tool holder to the drill press and drilled a small hole about halfway between the two ends of the hole and near the top, as shown.

I went over and found things working this way: He had ground his tools after a trial in such a manner that he did not need to remove the tool holder from the post for the different operations. By calipering up a couple of bushings, turned with the three tools, each set snugly back against the drill-rod stop, and taking note of the reading on the cross-slide graduation for each successive tool, he was able to insert the tool, clamp it and then by bringing the slide to the proper position with several cuts he needed only to caliper about one in a dozen to see if the tools were wearing away.

I thought the idea pretty good as it can be used on anything of this class where there are a number of pieces, but still not enough to pay for special tools.

The sketch accompanying shows the location of the drill-rod stop. It was put at the top of the square hole, he said, so dirt would not collect and spoil his measurements.

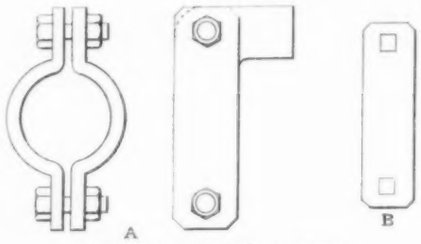
P. A. Fredericks.

Benton Harbor, Mich.

Tapping on the Drill Press

We recently had to drill and tap a number of deep 1-inch holes in some iron castings and not having any regular tapping device, I rigged up the following described cheap but efficient tap driver.

I got the blacksmith to make of 2½x½-inch iron, a clamp as shown at *A* with a



TAPPING ON THE DRILL PRESS

tail or driver on one side. He also made a lever *B* of about 2x¾-inch iron with a square hole in each end for different taps. We had a center for the drill press which fitted into one of the sockets.

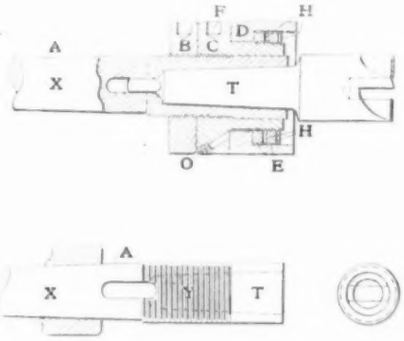
The clamp *A* was bolted to the lower end of the drill-press spindle just tight enough to drive the tap, and after the hole was drilled, the drill was replaced by the center, the tap with the lever slipped into place and the center brought down into the center hole in the tap. The machine was then started and the spindle fed down by hand.

The rig worked very nicely and the job was finished much quicker than if done by hand, beside making it easier for the workman.

Philadelphia, Penn. G. S. Y.

A Shell Stop for Drill or Counterbore

We have used a number of these stops in our shop and find them accurate and



A STOP FOR DRILL OR COUNTERBORE

useful. The drill or counterbore is of the ordinary type. The stock *A* is made of machine steel and is case hardened on the bottom end. The thread shown at *Y* should be of fine pitch so as to allow of fine adjustment.

The part *C* is made of machine steel and threaded to fit *A*, the hole at *F* being for the spanner wrench and the one at *O* for oil. The part *B* acts as a lock-nut.

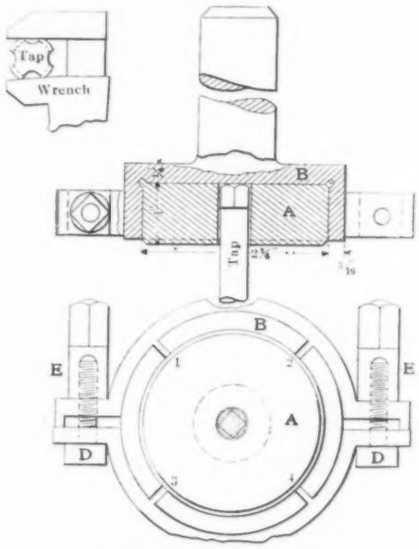
The shell *D* is case-hardened and ground to fit *C*. The nut and lock-nut *E E* are screwed up in place by a spanner in the slots at *H*, being screwed just tight enough so that the part *D* will run on *C* nicely. After inserting the drill or counterbore the part *C* is adjusted so as to give the required depth of hole and the lock-nut *B* is screwed down in place.

When the hole is drilled the required depth, the shell *D* strikes the face of the work and stops turning with the spindle until the feed lever is raised.

Washington, D. C. R. B. Lovejoy.

A Friction Tap Holder

The line cut is a friction tap holder, simple in construction, strong and positive, and can be adjusted to any size tap in an instant. One holder will answer for several sizes of taps. The shank is



A FRICTION TAP HOLDER

made to fit in the head of the screw machine; also with a Morse taper for tapping in the drill press.

The tap holder *A* is a machine-steel disk, 2¾ inches diameter by 1 inch thick, case-hardened; it has a hole through the center made a loose fit and shaped to the end of the tap. The front end of the hole is made round, to hold the tap up in the proper position to enter the work, the back end is made square to fit the square on the shank and drive the tap. *B* is a machine-steel holder (soft), bored to receive the holder *A*. It is machined all over and slotted at 1, 2, 3, 4, ⅛ inch wide. A forged-steel band 5/16x⅝ inch is made as shown and drilled to receive two ⅜-inch square-head bolts *D*, with special round nuts. The tap holder *A* is adjusted as follows: The holder, as shown with tap, is put in the screw machine or drill press. The tap is held between the jaws of a monkey wrench with the handle

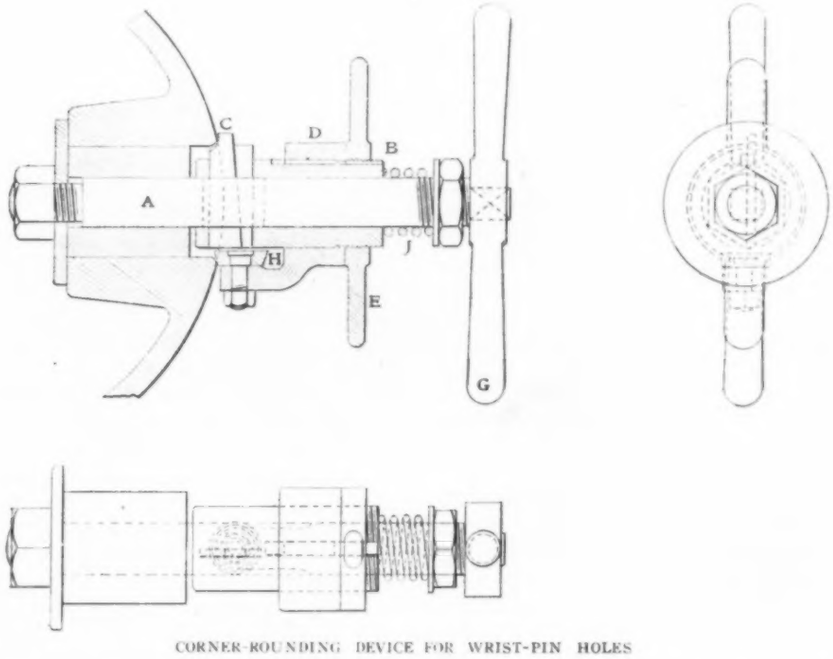
of the monkey wrench in the left hand. The tap is moved back and forth with a circular motion; this causes the disk or holder *A* to turn in the holder *B*. While this is going on with the left hand, with the right hand the band brake is adjusted at nuts *E E* until *A* ceases to turn in the holder *B*. It can also be adjusted by clamping the band tightly on holder *B*, and then with the wrench on the tap, hold it and release the brake band until *A* is free to turn.

Kenosha, Wisconsin. FOREMAN.

Corner-rounding Device for Wrist-pin Holes in Gas-engine Pistons

Recently I saw in use at a large gas-engine works a cutter similar to the one shown herewith for the above work. The tool makes a very good job in rounding the edge of the wrist-pin hole, which edge, of course, is not level, and if not beveled or rounded, becomes chipped and looks badly as well as offering a chance for a piece of metal to get loose and cut the cylinder. Further, it is much easier to insert the pin in the hole when the edge is properly rounded.

The tool shown consists of spindle *A* having a slot cut through to enable the cutter to move up and down and on this spindle a sliding bush *B* carrying cutter *C* is fitted, while upon bush *B* is fitted another bush *D* with key and roller. Also on bush *B* is screwed handle *E*.



CORNER-ROUNDING DEVICE FOR WRIST-PIN HOLES

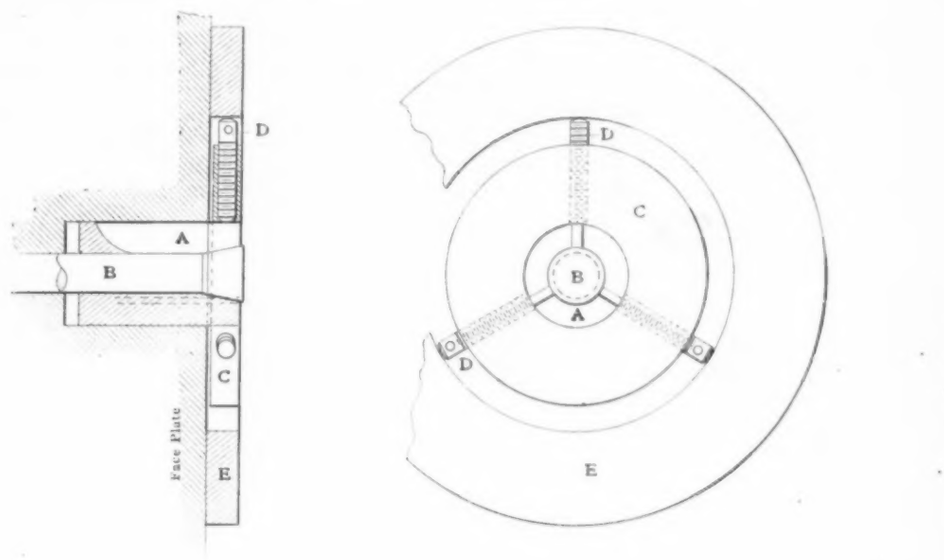
To operate the tool, it is placed in the hole as seen in the drawing, and nut *F* is screwed up fairly tight so as to bring the bottom of the slot in spindle *A* away from the cutter, which passes through the spindle. The long handle *G* is then turned by hand and as cutter *C* machines the corner, the roller, of course, follows the edge along with the cutter. Roller and cutter are kept to the work by a strong spring at *J*, which can be adjusted by the nut shown. To put on more cut, handle *E* is turned away from the hole; this, of course, allows cutter sleeve *B* to be pushed farther down by the spring, at the same time causes bush and roller *D* and *H* to go backward to small handle *E*. By having various bushes and a spindle long enough, one cutter will do for several sizes of pistons. The tool I noticed made a very successful job without much trouble.

It should be mentioned that the cutter is held in place by an ordinary taper key at the back.

London, England. T. A. J.

A Ring-grinding Fixture

We had a number of rings of hardened steel to grind on their two faces. They were 4¾ inches in diameter outside and 5/16 inch thick when finished. Their inside diameters varied from 2 59/64 to 2 63/64 and after hardening, these diameters were out of round. It was deemed unnecessary to grind the diameters, but the maximum variation from parallel permissible for the two sides was 0.001 inch.



A RING-GRINDING FIXTURE

Most mechanics would know that we would have a hard task grinding the two sides of a ring parallel in a chuck, but we tried it to see what we could do after having first ground up the faces of the jaws on the chuck. We spent half a day getting two rings ground to within 0.0025 inch of parallel. Then I had a small spider made, as shown in the sketch, which would fit on the "draw-in" chuck in the grinder face plate. This chuck consists of a 3-segment spring *A*, the outer end of which is parallel and moves in a 1-inch bore in the face plate. A draw bolt *B* with conical head expands the spring against spider *C* and draws into the face plate.

By 3/16 set screws *D* the spider could be tightened in a ring regardless of the exact size or condition of bore; both could be put on the "draw-in" chuck and pulled up to the face plate in half a minute. It was not necessary that the ring be exactly central with the spider, but we arranged for the ring to pull up against the face plate before the spider did. Thus the rings *E* were ground easily and within 0.00025 inch in about 20 minutes each.

R. H. WADSWORTH.

Indianapolis, Ind.

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Electrically Driven Tools

On page 350 is an editorial entitled "Electrically Driven Tools," which is not only incorrect as to fact, but also grossly misleading in its conclusions. We have always regarded the AMERICAN MACHINIST as an authority on any subject treated in its columns and its editorial comments especially carry great weight and influence. Such an article as the one mentioned is, therefore, calculated to do a great deal of harm, especially if allowed to pass uncontradicted.

The installation of one motor would probably be conceded to be a small motor-driven plant, yet if investors were deterred from installing it for the reasons you give, there would be few electrically driven elevators, few electrically driven pumps, few electrically driven fans, all of which represent far more difficult condition for the motor than occur when driving a machine tool and all furnish innumerable examples of successful motor operation without the assistance of an electrician. As a matter of fact, the motor is preëminently adapted for this very class of service, requiring a minimum of skilled attention or repairs.

The ills to which you state motors are prone and which are, at least in your opinion, something mysterious and with which the average mechanic is not at all familiar, are confined principally to the imagination of the uninformed. A most superficial inquiry of the operators of any motor-driven machine would elicit the information that less care, less repairs and fewer shutdowns were due to trouble with the motor than to trouble with the machine it was driving.

Most large plants support a tool room, partly at least, for the repair and upkeep of its equipment, but the fact that some small concerns do not do so does not prevent them from installing automatic machinery requiring intelligent care in its operation and a high grade of skill in its repair. For the same reason no small plant should lose the many great advantages of the motor drive even if it required an expert to keep its motors going, which is by no means true. The illustration you mention of the variable-speed planer is not as complicated an installation as the modern newspaper motor-driven press, and yet such installations are common and without the assistance of an electrician the presses are not shut down half the time, as we all know who get our newspapers year in and year out at the same hour every morning. These installations are cared for by the press operator and in the vast majority of motor installations the motors are cared for and attended to by the operator of the machine they drive.

In this age of specialization, we are not contending that, in a large installation, it would not be economical to have a special man attend to all motors, on the same principle that it is more economical to make machine repairs in the tool room than in the machine department, but we do contend that it would be the hight of folly to refrain from installing a labor-saving, dividend-earning device, because an insufficient number were needed to justify the employment of a special man to keep them in repair.

If the motor is a good motor, and we are presupposing that to be the case, and is correctly installed by someone who knows the requirements it will have to fulfil, there are no mysterious ills to be expected. Any handy man or machine operator of ordinary intelligence can be instructed in the care of the motor and there need be no stoppage due to any fault of same. The vast number of absolutely reliable and successful installations in operation today should be sufficient proof of the above.

The whole point is that it is the poor motor, or one not designed for the requirements, that has furnished the basis for your editorial and the writer is confident that the AMERICAN MACHINIST does not desire to take a position in opposition to so great an advancement in shop methods as the electric drive permits based on any such ground.

J. C. HOBART,
Manager, Triumph Electric Company.
Cincinnati, Ohio.

[The AMERICAN MACHINIST does not wish to be considered as having taken a position against electric-motor driving, for such is not the case. The editorial referred to by Mr. Hobart was merely intended to point out some of the limitations of the system.—EDITOR]

Pitting of Steel in a Barium Hardening Bath

Referring to the letter on page 461 in reference to the subject of "Pitting of Steel in Barium Hardening Bath," by John R. Godfrey, we wish to state we have had trouble with the steel pitting when hardening high-speed steel in barium, and after considerable experience we have come to the conclusion that it is caused largely by running the heats too high.

We are very particular not to run our hardening heats over 2150 degrees Fahrenheit, and since we have done this we have practically overcome the trouble mentioned.

New York. WHEELOCK, LOVEJOY & Co.

How Do Boys Want to Learn Trades?

Referring in general to the subject of boys learning trades, and in particular to the article by Ex-Manufacturer, at page 429, I believe there are a few points expressed in his argument that are not entirely applicable, especially in other localities.

In the first place, trade schools are a good place in which to start the development of a future mechanic. It is true, that boys like to "stand in the door and see something made," but many of those who stand and look on do not care to make the articles, and others could not on account of lack of ability. The trade school is the place to blow out the chaff (so to speak) and find the boy who is desirous of learning a trade, and who has the ability to make something of it. Then he is ready to start his apprentice course in a well organized factory.

I do not believe that manufacturers, as a whole, are opposed to the apprentice systems. The experiences of the General Electric Company, as noted in the system developed by Mr. Alexander and generally discussed in the press during the past year, surely do not indicate opposition. In fact, I believe it is considered to be a very successful enterprise. It is true that there is not much profit in a boy's labor for the first year or two, but, on the other hand, the total pay of the boy would not be such a great loss, especially if one were developing a man. In the present-day methods of cost reduction and piece work, there is not the opportunity for the development of the "all-round mechanic" in the regular course of work, although such a man is the one needed for foreman or general repair work, and to get him he must be educated. This education is best brought about through the trade school and apprentice system.

In bygone days a boy's vocation for life was generally settled by his parents;

today it is different; he must choose that which he likes and for which he is suited, else he will be lost in the competitions which he meets. Mark Twain truly said, "It is well that we are not all of one mind." This is especially so as regards boys. One boy gets a *job* in a factory because he likes to get next to nature, wear greasy clothes, see how things are made and eventually become a cog in the operating gearing of the universe. Another boy likes to keep clean, wear good clothes and have short hours, so he gets a *position* as clerk in an office or store. In a few years the first boy has a good job with good pay, and best of all, has good health; the latter boy has none of these advantages.

In conclusion, I believe that many boys want to learn trades especially if they have the opportunity, and, as my friend says, give us good trade schools with energetic and conscientious instructors who are able to lead the boys to "find themselves" as to what they are suited. Then follow this schooling with an apprenticeship in the line of work which seems to fit and there will be developed a class of men who are *mechanics*; men who are able to fill the positions of those who are so much needed. I hope the time is soon at hand when municipal funds, or private endowments, will be available for the establishment of trade schools with this end in view.

Boston, Mass. L. C. Brooks.

Tapping Attachment for the Acme Automatic

Having for a number of years come in contact with the operation of Acme automatic multiple-spindle screw machines, I have been interested in the articles by A. Klein, page 927, volume 31, Part 1, and of C. M., page 317.

Referring to the illustration accompanying Mr. Klein's article, it appears that the device in question, while containing a number of good points, is somewhat intricate, and besides requires that the stock spindles must be run right-hand instead of left-hand—the latter is in accordance with the general design of the machine. As the manufacturers of the Acme are building a machine for general screw-machine work, I can scarcely see how they could afford to practically reconstruct their threading mechanism to accommodate this device, which would naturally be used only occasionally in a factory where the work is of a general nature.

Taking the advantages claimed by Mr. Klein in order, I find the first to be that the necessity of stopping the spindle in the threading position is obviated. To my mind the feature of stopping the rotation of the stock spindle in the threading position is one of the strong points of the Acme, not only on account of the advantages in threading, but that it makes possible the performing of many special operations, such as, side milling, end milling, cross drilling, and in some instances both cross drilling and end milling, which would otherwise be impossible. Thus it enables work to be completed on this machine, which, heretofore, has required one or more additional operations. These special operations can—to a certain degree—be performed on some of the single-spindle automatic screw machines now on the market, but in most instances the output is reduced proportionately. This is not the case with the Acme, as all operations are performed simultaneously; but up to date no other multiple-spindle machine is able to accomplish these special operations because of its inability to check the rotation of the stock spindles.

The second advantage claimed depends entirely upon the duration of the tapping operation being the longest operation on the piece. The percentage of automatic screw-machine work, where the tapping operation is the longest, is usually very small. In this particular instance, however, there is no question but that Mr. Klein's device might show a little economy, but whether sufficient to justify the increased cost of the device is problematical.

The third advantage does not appear to be very strong, as I have seen as many as three distinct operations being performed in the position where the spindles are stopped for threading, namely thread rolling, cross drilling and tapping. In this particular case the rotation of the spindle was not stopped until the thread-rolling operation had been performed, after which the cross-drilling and the tapping operations were completed; the only change necessary to accomplish this was the correct timing of the mechanism, which controls the rotation of the stock spindles in this position.

On C. M.'s article very little comment is necessary, except to state that he does not seem to be uptodate on the Acme automatic, inasmuch as he advocates running the spindles right-handed in order to cut a left-hand thread. I have used for two years a device for cutting left-hand threads, furnished by the manufacturers of the Acme automatic which, while very simple, does not require that the machine be run right-handed. He also advocates threading by rotating the die faster than the stock upon which the thread is to be cut. This is an old principle and, I am under the impression, one of the first tried by the manufacturers of the Acme, but inasmuch as the one now in use gave much better satisfaction and made it possible to perform the special operations heretofore mentioned, this idea was abandoned by them.

When the possibilities of the Acme multiple-spindle screw machine are generally understood, it is my experience that the results are far beyond those obtainable on any other style of automatic screw machine of its range.

Wm. B. Woodhouse.

Syracuse, N. Y.

Distinction Between Burnt Steel and Overheated Steel

The article entitled "Restoring Burnt Carbon Steel Tools," on page 366 of the American Machinist, brings to mind the fact that the distinction between burnt steel and overheated steel is frequently lost sight of. Overheated steel is, as the term implies, simply steel which has been raised to too high a temperature, but not necessarily burnt. The fracture in such a piece shows a grain very coarse or open, as is described and illustrated in the article mentioned, and may be "restored," or refined by the simple process of cooling and reheating to a temperature in the neighborhood of a dark red, the proper temperature varying somewhat in different steels. This is essentially the same process that the smith employs in testing a new bar of steel to see how it "refines." Such steel may also be refined by careful working under the hammer. The coarseness of grain in overheated steel varies with the last high temperature to which it was raised, that is, the higher the heat above a dark red, the coarser the grain, the changes taking place as the temperature rises and not as it lowers.

With burnt steel the case is different. Here there is not only the difference in structure but a difference also in composition, particles of the steel having united with oxygen. To make matters worse, the formation of this oxide is accompanied by a partial decarbonizing of the steel. After steel has gone through these changes its restoration would present quite a problem.

Steel which is merely overheated may be refined and strengthened by proper heat-treatment similar to that described in Mr. Coles' excellent article, but "burnt" steel is worthless.

Tucson, Arizona. W. W. Henley.

A Tapping Center

On page 389 Walter E. Malo says he cannot see why I should go to so much trouble as to make a "spring tapping center" when, by disconnecting the counterweight of the spindle one can get the same results. This is a very ingenious method, but, it can only be operated when tapping in the drill press.

By taking the center out of the tailstock of a lathe and putting in a chuck one can use the "spring tapping center" to a very great advantage, and I may say that I have used it more in a lathe than in a drill press. I omitted to mention this when I sent in my contribution.

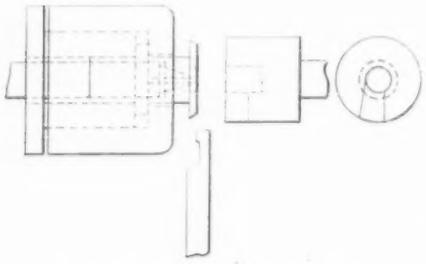
New Haven, Conn. J. R. Jarvis.

Turret Lathe Tool for Chamfering Washers

On page 18 James Klein shows how to bevel washers. I think the support at the back of the washer is a fault, as the washer would be inclined to rock and give the tool a chance to be greedy when cutting.

The accompanying sketch shows another way of doing the same job, and also facing the washer at one operation. I have made many thousands by this method and have had no difficulty in the operation. I think it is a quick way of doing the job. One advantage of Mr. Klein's method is that he can use his tools in an ordinary lathe, but in this case it is essential to use a capstan or turret lathe.

From the sketch it will be noted that all that is required is a special chuck fitted in the bore of the spindle, with a collar that can be firmly clamped by the nose of the machine. This projects far enough so that the end can be turned



TOOL FOR CHAMFERING WASHERS

down to fit the washer, which is slotted to form a spring chuck. The inside is coned out a suitable angle so that a rod, that is a sliding fit with the end turned to fit the cone, takes the place of the long sleeve which works the spring chucks in the ordinary way. This is operated by the lever which opens the chuck by being forced into the cone, which grips the washer.

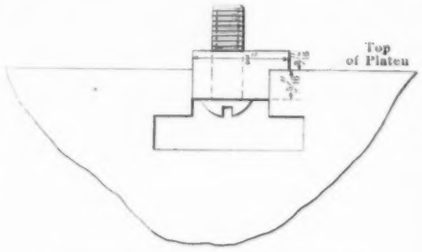
In the turret is fitted a stem bored out to clear the end of the chuck. This tool is to keep the washer flat against the shoulder while being turned. The turret slide can be set so as to come up to the work and be held there with the right hand, or in case there are large quantities to do a treadle is fixed so that by pressing it with the foot it brings the slide up against the work, leaving the right-hand face to put the work on. The left hand works the feed lever. The slide is drawn back by a weight or spring. The beveling is done by a tool fixed in the cross-slide, and shaped as in the sketch, which allows it to be ground on the top and point.

London, England. C. PETITJEAN.

Standard Fixture Tongue Blocks

The standard tongue blocks (or slot keys) used with the fixtures and jigs at the Lucas Machine Tool Company differ somewhat from those shown on page 240.

These blocks are made like the sketch here shown. Selected drawn steel 1x½



STANDARD FIXTURE TONGUE BLOCK

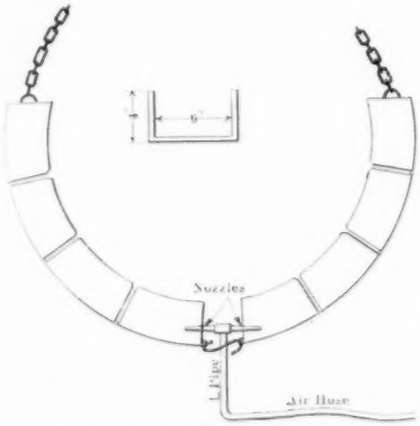
inch is cut off 1½ inches long and then one edge is milled off the required amount. This is easier to make and easier to check up when made. A 5/16-inch screw is used to hold blocks in fixtures to prevent them falling out through the vibration from cut.

The part of block extending into platen is made deeper on account of the bevel at the edge of slots. Fixture slots are planed 1 inch wide 13/64 inch deep.

Cleveland, O. H. T. GREEN.

Taking Off Locomotive Tires

Seeing the article of H. K. Andruss on locomotive tires, I give the following that may be of interest to readers who meet with the same trouble. It is not necessary to take the wheels out from under the engine. First get eight pieces of sheet



TAKING OFF LOCOMOTIVE TIRES

steel 12 inches long and 14 inches wide, which can be cut from scrap ash pans or anything that is handy, and bend them, as shown in the cut. Join together like a hinge in two sections of four each and hang under the tire with a chain. Then take a piece of ¾- or 1-inch gas pipe and fasten a T on one end. Take two pieces of pipe 6 inches long, point one end of each like a nozzle and screw into T. Fasten a piece of hose on the other end of the pipe and attach the hose to the air of a live engine; put wood in your sheet boxes, light it and turn on the air. In a short time the tire will be heated and can be taken off.

If new tires are to be put on, have them outside of the shop on their respective sides of engine and have a fire around them while you are taking the old ones off, and when you have one side off you can put the new tires out while changing burner and air rigging to the other side. With four men I have taken off side rods and renewed eight tires and have side rods back on the engine in 9 hours by this method, the engine being blocked under the boxes and jacked up high enough for the flange of the new tire to clear the rail.

Lebanon, Penn. WM. O. KOSTER.

Welding a Shaft

E. C. Oliver's contribution on page 201 is quite interesting, and from his description of the job, I judge the shaft must have been mild steel of a nature to resist taking "hold" when heated to a high tem-

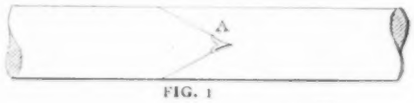


FIG. 1

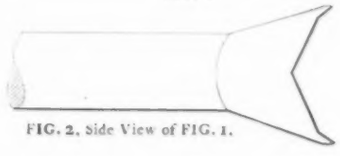


FIG. 2. Side View of FIG. 1.

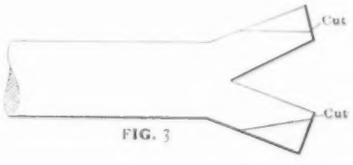


FIG. 3

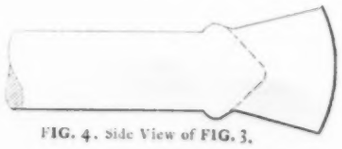


FIG. 4. Side View of FIG. 3.

V-SCARF FOR WELDS

perature. It is seldom a "butt" weld, that is, a perfect job, can be successfully made with this class of material.

Mr. Oliver's smith certainly selected a unique, and to my mind, a freak way of accomplishing a badly begun job, and while it apparently came out all right I would not trust much to its strength when it was again placed in position.

If he had "made haste slowly" and prepared his shaft ready for welding with a well-made, old-fashioned V-scarf, he would probably have done the job in one-half the time, and had a job he could swear by when finished.

The V-weld, like most other things, must be known to be appreciated. As there are few smiths that use them and

they are of importance on such jobs as Mr. Oliver describes, I will explain them for the benefit of those who wish to profit thereby. I was unable to do a good job on work of this character (especially steel) until I understood them.

The principal trouble experienced by most smiths in making a V-weld, is in closing the gap *A* between the male and female, as shown in Fig. 1. The usual reason for this gap is, that both scarfs are made parallel and the point of the male at *A* wastes away to a certain extent.

To avoid this I widen the point of the male at least ½ inch wider and shaped it as in Fig. 2. The female is split and the sides chiseled off, as shown in Fig. 3. The lips are worked down to about ⅛ of an inch in thickness and allowed to widen all they will. A small fuller is then worked in the crotch until it assumes the shape shown in Fig. 4. The female is then heated up, the male rammed in until a snug fit is made and the lips are rounded over the opposite piece as closely as possible.

If done right, the weld holds tightly, knits together easily and there is an abundance of stock to close all gaps and cracks and insure no dirt getting in the joint while in the fire. I find also that this form requires much less borax to flux it than is needed on the old style V-weld. With a good clean fire and a slow soaking heat it goes together in a way that will convince the average smith, it is there to stay.

Mr. Oliver does not say how much time or trouble it took to get the pins and holes centered so the pieces would fit together properly, but I imagine from experience that it took some nice calculating or an elaborate laying off of the holes to accomplish it. But then, there is such a thing as "bull luck" that sometimes beats cool calculation to a standstill.

St. Louis, Mo. T. Toot.

A Difficult Core

On page 97, I noticed an article on making a difficult core. Wilfrid George, Birmingham, England, explains a method which he saw a man use in an English job shop. Now in considering the same article, a box iron chimney, it seems strange that such methods would be practiced especially in a job shop. The proper thing would have been to take the pattern and make a plaster cast. Then take the plaster, cut off the flange at *A*, then scribe a circle with a radius 1/10 inch less than that at *A* on the round end, then take a scratch gage and gage 1/10 inch around the triangular end. Next take an ordinary thumb tack and file the point off until it is 1/10 inch long from the head and with this starting on the points of the triangle and following along on an imaginary center to the round-end prick holes as deep as the tack will admit, i.e., 1/10 inch, then between these three center lines prick holes 1/10 inch deep and about ⅜ inch apart. Then with the skill that the (wood) patternmaker is supposed to have with his knife he will have no difficulty whatever in whittling this 1/10 inch off.

After he has removed the 1/10 inch all around he will then make another plaster cast which in turn can be molded in the foundry to produce the final metal core box.

Lawrence, Mass. S. E. Allen.

The Fitchburg and Worcester Trade-school Plans

Some time ago, on page 19, I expressed an opinion in these columns to the effect that the Schneider plan of education, as practiced in Cincinnati, would be better adapted to trade-school purposes than to colleges or technical schools. Therefore, as soon as the Fitchburg scheme, which was so fully described at page 397, was adopted I immediately began to look up the matter, thinking to find there the scheme of which I expected much.

I found that the movement appears to be fostered by the local association of manufacturers of metal work, which is known as the Iron Workers Association, and is furthered by the city government through the high-school committee. The system is based frankly on the plan of Professor Schneider and had its inception at a visit which he paid to Fitchburg last spring. Following this visit the mayor and president of the Iron Workers Association went to Cincinnati to look into the work there, and to visit the shops where the apprentices are employed. They returned satisfied that a modified form of the Schneider plan was just what Fitchburg needed. They quietly went to work, and in the summer put into operation a school which has its good points and its bad ones. It embodies some changes so considerable from the Schneider plan that it seems worthy of earnest consideration.

The Fitchburg Trade-school Plan

The Schneider plan emanated from the college; the Fitchburg plan from the manufacturers. In Cincinnati Professor Schneider is "it;" in Fitchburg, with all respect to Superintendent of Schools Edgerly, the manufacturers are "it." They have dealt the cards so that they of necessity must remain "it" for some time. In Cincinnati Professor Schneider can say to his manufacturers, "here are these boys; if you will do so and so you can have them," and he can see to it that the boys receive nearly what they earn by reason of his position. In Fitchburg the manufacturers have a contract and a bond which binds the boy to them. While the schools can dismiss the boy they cannot in any way influence the employer. To be sure, there is no doubt but that these Fitchburg employees have the best interests of the plan at heart, and that their pride will help to make them work for the success of the scheme. The danger lies in the possibility that new blood, more alive to the last cent of profit and less patriotic, may some day take their places. The same weak point is in the Schneider plan, from the fact that Professor Schneider is undoubtedly mortal. A plan for general success must not depend vitally upon one man, or a few men, whose successors cannot be trained to fill their places.

A difference between the two propositions lies in this: In Cincinnati the product wanted is engineers who shall incidentally have an abundant shop training; in Fitchburg what is wanted is machinists with a broader and more practical book education than their predecessors. To accomplish this end in Fitchburg, the shops of the members of the Iron Workers Association have agreed to take a number of apprentices—30 or 40 a year—under conditions which very exactly approximate those in vogue in the past, and which are embodied in the rules and regulations which were printed in these columns. Under this agreement the apprentices are bound by their parents and bondsman, who agrees to forfeit $100 in case the agreement to work the stated number of hours, etc., as per rules and regulations, is broken by the apprentice. The manufacturer promises to give the boy work and pay him certain sums of money, and then stops, or rather backs down. For "the employer reserves the right to suspend regular work wholly, or in part, at any time that it may be deemed necessary, and agrees to provide other work at the regular rate of pay, for the apprentice during such period." The employer furnishes no bond nor, in fact, does he really agree to do anything except to take the boy and let him work at something, and pay him a stated wage for a stated time. The possibilities in other hands than those which now have the helm are at least disquieting.

It will also be noted that no opportunity is given a boy, who has once signed the agreement, to change shops, or in any way modify his course. The only outlook for the round boy who finds himself in a square hole is in the clause "should the conduct or work of the apprentice not be satisfactory to the employer, or to the high school, he may be dismissed at any time without previous notice. Dismissal by the employer carries with it dismissal from the coöperative class, etc., etc."

The most noticeable feature of the plan is that it apparently costs next to nothing. Seeing this I went over to Worcester where they now have a proposition to spend $100,000 or more in starting a school for this same end.

The Worcester Trade-school Plan

The problem in Worcester is similar to that in Fitchburg, only there the high schools are crowded to the bursting point, and the superintendent of schools is asking that the city build another school to take care of the surplus rather than to take in pupils on a part-time schedule. In Worcester the contention is made that the cost under the State law will be no more per pupil per year than in the present high schools, since the city is in a position to claim one-half the cost of maintenance from the State.

It has been intimated that there ought to be some way of making the public-spirited Metal Trades Association "cough up" some of the equipment of the school shop, since by its establishment, the shops of its members will have an increased number of profitable workmen, who may take the place of apprentices. None of these manufacturers has admitted the fact that his apprentices were profitable.

A Few Comparisons

Seriously, however, it may be taken as a fact, that everything costs, and that all costs may be divided into necessary expense and waste. The question is, which plan, the Fitchburg plan, or the Worcester plan, has the least waste. At first sight it would seem plain that the Fitchburg plan, involving the city in practically no expense and paying the boys wages, was by far the least wasteful. Thus the boys are to give four years' time, and in return are to receive $544.50 in wages and a trade. In Worcester they are to give the same four years and learn a trade, but receive no money. Presuming that the boy may continue to work for 30 years after leaving the school, it becomes only a question of whether the Worcester-trained boy can earn six cents a day more on the average, than the Fitchburg boy. The advocates of the Worcester school claim that the difference between their boy, who is under an instructor whose business it is to teach the trade, and the Fitchburg boy, who is under a foreman whose business it is to get out work, will make the six cents difference look small. As for the difference in expense to the city, Worcester hopes to sell more or less of the product and thus reduce the cost of education per pupil enough below the present cost for high-school pupils, to pay the interest on the investment.

The apparent onesidedness of the Fitchburg agreement between apprentice and employer seems to me to have been entirely avoidable. It may well be said that all these employers are men of known integrity; that the success of the whole matter depends entirely on their doing what they ought to do. On the other hand it may also be said, that the integrity of a student and his father should be none the less because they do not own land and buildings, and that it is as much to the interest of these parties to the agreement that the thing should be carried through in the proper spirit. In this case no agreement is necessary, much less a bond. If an agreement is necessary it seems as if the employer would be likely to stand in much better light with the public, if he also was under an equal bond to fulfil some definite agreement.

Next I noticed that the course of study was entirely different from that offered to other students in the high school. I would criticize the placing of the entire study of mechanics in the first year. College students of 21 or 22 years of age do not find themselves any too mature for a comprehension of the principles of the subject, and it seems to me that if the subject is arranged so that it can be handled by these extremely young boys that they will suffer in the end, as compared with what might be done with the subject carried through all the years of the course. A boy's brain can hardly be rated as an empty hole into which knowledge may be dumped, but rather a sponge, which, if given time, will absorb a large amount and still readily respond to judicious squeezing. The discussion of current events, if it can be kept away from religion, politics and base ball, is a splendid conception; though I must admit that it seems as if it would be just as good in the second and third years as in the first and fourth. The amount of drawing offered, in both the Fitchburg plan and the Worcester plan, is far in excess of that given technical under-graduates. There is danger that graduates may find it easy and attractive to go into drafting rooms, rather than into shops. I say danger on the boy's account, not the shop's; I believe that the best path for boys who might graduate from either school lies in the shop.

The Human Element

So far the balance between the two systems seems fairly even; now for the human element. I feel that I have maintained an acquaintance with the man in overalls that entitles me to believe that I can find out how working people look at various matters. That is, no one seems reserved or timid about speaking his mind to me on any subject.

My next effort was to find out how men whose sons might be most benefited, looked at the two propositions. Mind that this did not mean that I went to labor leaders alone, for organized labor does not have any greater claim than unorganized. There is this feeling which manufacturers do not generally believe exists, though I feel that its truth is undeniable; a feeling of discontent and distrust toward employers. It runs high enough so that it seems unlikely that any trade school can reach the boys who need its influence most, if it is fostered by any private interest. I do not believe that workingmen in Fitchburg will support the school as started there, nor would they if it was fostered by labor alone.

Everywhere I have met the same opinon, "schools should be run by the government; every child should have an equal opportunity, whether rich or poor, whether able to furnish bonds or not."

Whether the best scheme is the Worcester plan, or not, is an open question, though I cannot help but feel that the Worcester plan is the more politic way to meet a condition which must be recognized before real progress is made.

Springfield, Mass. Entropy.

Hand-turning Operations in the Lathe

Permit me to thank Mr. Webster for his kindly but hasty criticism at page 244, of the above article. It is a set-off against the many complimentary letters I have received from many distant parts of the United States. Had Mr. Webster left out the "ifs" and "buts" his letter would be almost entirely corroborative of my article.

First he states that hand tools make a fair show, etc. This is exactly my contention; next he mentions myself and associates. I remind him that I have no associates in the matter in question and his remarks about hard thinking and special grinding machines do not apply to the work done by hand tools conditional to the statements made in the article. I refer him to the illustrations of work done by hand. Grinding is not applicable to these articles for the quantity and price paid for them. Referring to his question: "Why do intelligent engineers use hand tools and engine lathes to produce handles, knobs, etc.," I answer, "For the very simple reason that to produce the small quantities and patterns required by them it does not pay to have special machines." Mr. Webster's statement that it is unnecessary to true up the tops and sides of the teeth of gears is so absurd that I leave the matter for your readers to decide for themselves without further comment. His admission that the Lancashire textile machinery makers produce cheap work by the older methods entirely justifies the purpose of my article, and this fact is confirmed by the Board of Trade report for August, 1908. The value of textile machinery exported was £676,384, a great portion of it being sent to Japan, the United States and South America.

The wage question Mr. Webster has introduced is irrelevant, as the object of the article was to show that work could be produced by hand tools advantageously. His remarks about conservative engineers, etc., are ill timed, but to enlighten him I beg to inform him that the gentlemen alluded to are managers of some of the best money-making shops in the country.

who either go or regularly send representatives to the United States seeking new tools and appliances to cheapen their production. Mention of this brings to my mind a very old friend who went from Oldham a few years ago; he was a man who had probably more lathe operators under his supervision than any other man of his time. On his return I had many conversations with him and his opinion I voiced in my article. And I may also add that it was while on a tour of inspection through the engineering shops in the States that the suggestion was made to me to write the article in question and it was at the instigation of a circle of engineering friends that I did so.

Modern machine-shop practice and the development of new labor-saving tools and appliances have no stronger advocate and admirer than myself. Yet there remains the fact, admitted by Mr. Webster, that there is still room for hand-tool operations in the lathe.

Manchester, England. JAMES LOMAS.

Tool Posts and Other Lathe Details

I wish to say "hear, hear" to Mr. Godfrey's remarks on page 422 on tool posts and spindles. The tool block should be lower and there is nothing to be gained in having interchangeable chucks, etc. (especially in a job shop) as each machine has to have its full equipment anyway. This is from experience, as we have several sizes of lathes which have duplicates. They were bought alike in order that we might have as few chucks as possible, but were not run a year until full equipment had to be purchased for each machine because a chuck would be in use on one machine when it would be badly needed on another. Special equipment is used so seldom that arrangements can always be made to use it on the machine for which it was made.

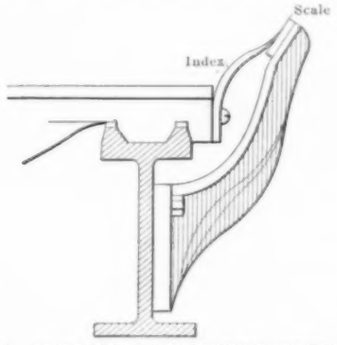


FIG. 1. SCALE FOR LONGITUDINAL TRAVERSE OF CARRIAGE

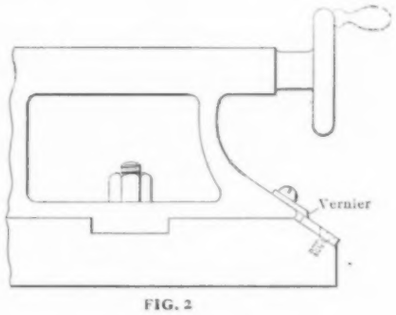


FIG. 2. VERNIER FOR TAILSTOCK

A feature of lathe design, which I do not like is the practice of putting the thrust bearings for end play between the two spindle bearings, or using a hollow set screw at rear end of spindle while the opposing thrust is taken by front bearing. If the spindle heats slightly it expands and binds between the two.

This is especially noticeable in a 14-inch lathe in our shop where, if all play is taken out by adjusting the thrust and then the lathe started on the high speed (580 per minute) it sticks the machine in less than 30 seconds. If the play were taken up on either side of the same spindle bearing then any expansion would increase the play rather than clamp the spindle.

A LATHE-BED SCALE

Now for an original idea. We have graduations on the drill press, the milling machine, etc., and we have them on the tailstock spindle and the cross-feed, all of which is very good, but I would suggest that we go a step farther and mount a scale on brackets extending out and up from the back of the lathe bed so as to bring the scale about 3 or 4 inches above the carriage. This scale should be the length of the travel of carriage on the ways and an index finger should be mounted on the carriage to agree with the scale. The back of the lathe is the only position where it can be placed and it should be high up to keep chips from it. Fig. 1 shows the idea.

This may seem a radical change and I would not recommend it for large lathes where it would probably be in the way. Its uses would be numerous in such work as boring blind holes, recessing and counterboring holes which would be much simplified and the threading of blind nuts would be made easy. There would also be a considerable saving in time on work turned to shoulders, etc., such as an armature shaft.

While on the subject of graduations, I would like to say, that I think it would be a good plan to have a vernier scale on the back of our tailstocks, at the joint between upper and lower parts, so that accurate adjustments could be made, the scale should be set at an angle of about 45 degrees so that it could be read from above. With this scale a trial cut could be taken and calipered with the micrometers, then the errors could be divided in half, and the tailstock set over within 0.0005 inch of the right amount without further trial. One scale should be adjustable, to bring zero marks correct in case of wear. The plan is shown in Fig. 2.

Ottawa, Canada. JOHN STEVENSON.

A Draw-in Chuck for an Engine Lathe

At page 913, Vol. 31, Part 1, Mr. Dixie describes the construction of the draw-in chuck for engine lathe as in use by Edward Board, of Philadelphia. At the time I was interested in it and compared it with the one which we use and which has done service for several years in this shop. The construction, it will be readily seen, is simple, strong and very practical.

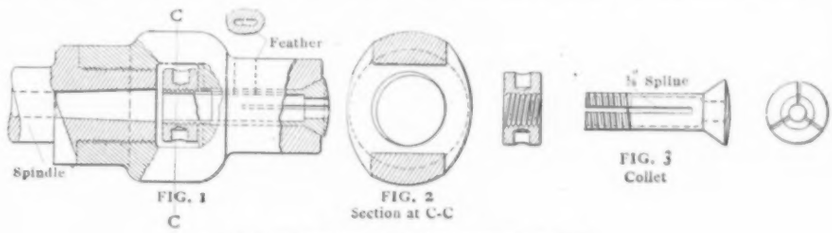


FIG. 1

FIG. 2
Section at C-C

FIG. 3
Collet

A DRAW-IN CHUCK FOR AN ENGINE LATHE

We have two parts only and one thread fit as against four parts and the two thread fits in the one shown by Mr. Dixie.

Possibly the object of Mr. Board's construction was to adapt the collet chuck end to the various spindle threads of his lathes, this by means of the additional nose pieces for each spindle thread. The hardened-steel ring for the taper fit of the collet is a good feature in his construction.

Figs. 1, 2 and 3 show clearly the construction and details of this draw-in chuck and also one of the collets. The capstan holes are readily got at for drawing in, using the pin lever through the very liberal cored space, shown in the cross-section through that portion of the chuck.

Groton, N. Y. AMBROSE.

A remarkable watch was exhibited at the Franco-British Exhibition that is said to have been made to order for an American at a cost of nearly $5000. It had a front and rear dial, and strikes a gong for hours, halves and quarters. It designates sunrise and sunset, equation of time, and Greenwich mean time. The moon's risings and settings are shown, accurate account of the tides is kept, and a calendar showing the day and month automatically adjusts itself. Besides high and low water indications astronomical events are shown.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

505 Pearl Street, New York.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

Subscribers can have address changed at will. Give old and new addresses.

Subscription price $4 per year, postage prepaid, to any post office in United States, United States possessions and Mexico. $5.50 to Canada. $7 in all foreign countries except Europe and British possessions in Eastern Hemisphere.

Hill Publishing Co., Ltd., 6 Bouverie St., London, E. C., will serve all subscriptions for Europe and British possessions in Eastern Hemisphere. Price 30 Shillings for England. For all other countries in Eastern Hemisphere, 35 Shillings.

Entered at New York Post Office as mail matter of the second class.

Cable Address, "MACHINIST," N. Y.
Business Telegraph Code.

CIRCULATION STATEMENT

During 1907 *we printed and circulated* 1,151,500 *copies of the* AMERICAN MACHINIST. *Our circulation for September,* 1908, *was (weekly, monthly and European)* 90,250.

Oct. 1	33,000
Oct. 8	18,750
Oct. 15	18,750
Oct. 22	18,750

This paper reaches 33,000 *separate readers each month and* 18,750 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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A Reversion to Type

The twist drill of our grandfathers, and even of the fathers of some of us, was true to its name, and even truer to the name by which it was undoubtedly first known—twisted drill. In its earliest form it was probably an ordinary flat drill, heated in the blacksmith's forge and twisted to a more or less even helix. Such drills were homemade, and the type of shank or provision for holding in a chuck depended upon the devices and facilities that the shop afforded.

One lot of such drills that were in existence a few years ago and, if they have been kept out of the junk box, must be now all of 70 years old, were made by forging square stock into a flat, twisting the flattened section thus formed, spreading the point in order to get the desired size and to clear the body of the drill, and forging the square shank into a rough taper to fit a square tapered socket. These drills were made in the plant in which they were used, but were not looked upon as successful. In addition to the usual difficulties in getting a hole of a desired size and accuracy with flat drills, these flat, twisted drills probably tended to untwist if used for hard drilling, because they were only tempered for a short distance back from the point and the rest of the twisted body was soft. Such a drill would untwist from a given position more easily than it would increase that twist from the application of a given force.

Such were early twisted drills. Modern twist drills or, as they were early known, American twist drills have undergone but little change in type since they were first put on the market. But in the last year or two a new type of drill has come into prominence, which can be properly characterized as a "reversion to type." We refer to the flat, twisted, high-speed-steel drills. These resemble in many ways the early twisted drills. They are made from flat stock, are twisted, and are produced with a variety of shanks to adapt them to various holding devices or chucks. They are, of course, a more highly developed product than the old twisted drills; for the bodies are ground to exact size, the lips are ground to correct angles, and the results from their use are comparable with those from regular twist drills. Another point of resemblance is the fact that in some large factories such drills are made instead of being purchased. This is possible for the special tools required in their manufacture are comparatively few; in no way comparable with the expensive tool outfit that is required for the economical production of fluted twist drills.

The reason for this development is apparent to all: It is in a demand for a drill made of high-speed steel that will compare favorably in cost with regular drills. As the cost of high-speed drills is in a large measure in the steel, and as a twisted drill requires only about one-third as much steel by weight as the regular drill of the same size, it can be seen that the saving is considerable. Reversions to type are watched for and commented upon with interest by scientists in many fields; here is an interesting reversion to type in a machinery industry.

Men versus Natural Advantages

Which element has the greater influence upon the successful upbuilding of a manufacturing plant, the personality, qualifications and energy of the executives, or natural advantages, such as native raw materials, markets, and the like? Should anyone attempt to answer this question from the impressions of a trip through an abandoned manufacturing section of New England, like the Blackstone valley of Massachusetts, he would say that natural advantages were a determining factor in the upbuilding of an industry. Should this same person study the growth of certain manufacturing towns that might be selected, and base an answer on the facts thus presented, his answer would be, "Men are a greater determining factor in industrial progress than natural advantages."

We have in mind two large towns in one of the New England States. The one has many natural advantages for a manufacturing center, the other has very few. The one is traversed by two important railway lines, one of which is a double-tracked trunk system, and connects the town directly with Boston and New York; besides connections that put it in touch with all the important manufacturing cities of New England. The other is on a single-tracked branch line that has been the butt of railroad jokes in New England for a generation. The one has an ample and easily utilized water power; the other has practically no water power. The one has comparatively level land, well adapted for building sites; the other is rough, hilly, and filled with New England ledges. The population of the more favored town has remained practically stationary for 20 years, and in fact some censuses have shown a slight decrease. The population of the town possessed of the fewer natural advantages has doubled in the last 15 years, and is today growing very rapidly owing to the rapid growth of the town's industries. The location of markets for the purchase of raw material and for the sale of product can have but little influence, as the character of the manufacturing in the two towns is similar, and they are only about 40 miles apart.

Why has the one town grown so much more rapidly than the other, although seemingly at a disadvantage? Mainly because of the personnel of the men who were and are at the head of the business life of the place. They are alert, keen, determined to build up their industries, and thus their town. Their results have been amply paid by well merited success.

New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

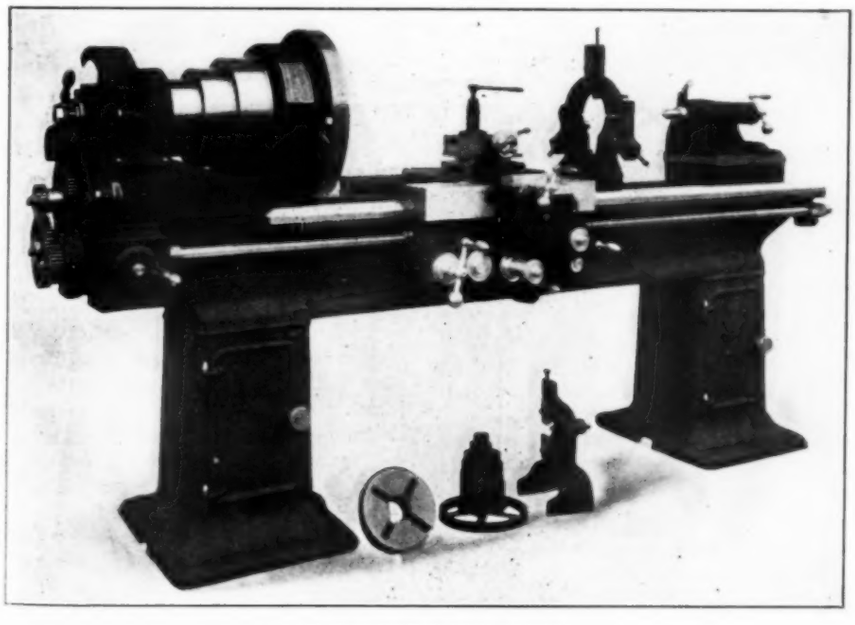
THE LATEST INFORMATION

A Plain Change-gear Engine Lathe

This lathe is similar to the cone-driven lathe made by the John B. Morris Foundry Company, Cincinnati, Ohio and recently illustrated in these columns.

The quick-change-gear device is omitted from this lathe and the lead screw also acts as a splined feed rod. Eleven change gears give all the standard threads from 2 to 72 per inch. The feed box gives three changes for each gear being controlled by the small handle shown at the left. This gives a feed of 0.005, 0.009 and 0.014 inch per spindle revolution when lathe is geared for its finest thread. This feed change is accomplished by the crank shown on the front face of the speed box below the headstock. A quadrant is fitted to the feed box and is clamped to it by two screws which fit the tool-post wrench as is the case with all of the adjusting screws throughout the machine. The change gears are secured to the stud and screw by slip washers so it is not necessary to remove the nuts when changing the gears. When the crank shown on the face of the speed box is to the right, the clutch connects the lead screw direct with the change-gear stem and the two other positions for this crank connect sliding gears which give two more extra feed changes.

This has the double apron and includes a mechanism for rough-chasing all threads without the use of the lead screw. The back gear speeds are driven direct into the face plate or chuck and the highest ratio is 17 to 1. The largest step of the cone pulley is 12 inches in diameter by 3 inches face. It is also made in 14- and 16-inch sizes.



PLAIN CHANGE-GEAR LATHE

A Large Seaming Press

The E. W. Bliss Company, Brooklyn, N. Y. has recently built the automatic side-seaming press shown in Fig. 1. The body blank comes to the machine already rolled and is clamped in the carrying rings shown. These, in addition to carrying the blank into the machine, maintain the correct size of the body which is necessary to insure a good fit of the top and bottom. There is also a gage which prevents too long an end extending on the outside of the can. After the blank is clamped, the carriage is moved by the large hand wheel until the blank is in position over the horn and ready to form the seam which is shown in Fig. 2. The horn on which the can is seamed has a sliding blade operated by a cam from end of crank shaft. To make the first stage of the seam this blade is raised above the top surface of the horn in position for the outer slide to do the forming, after

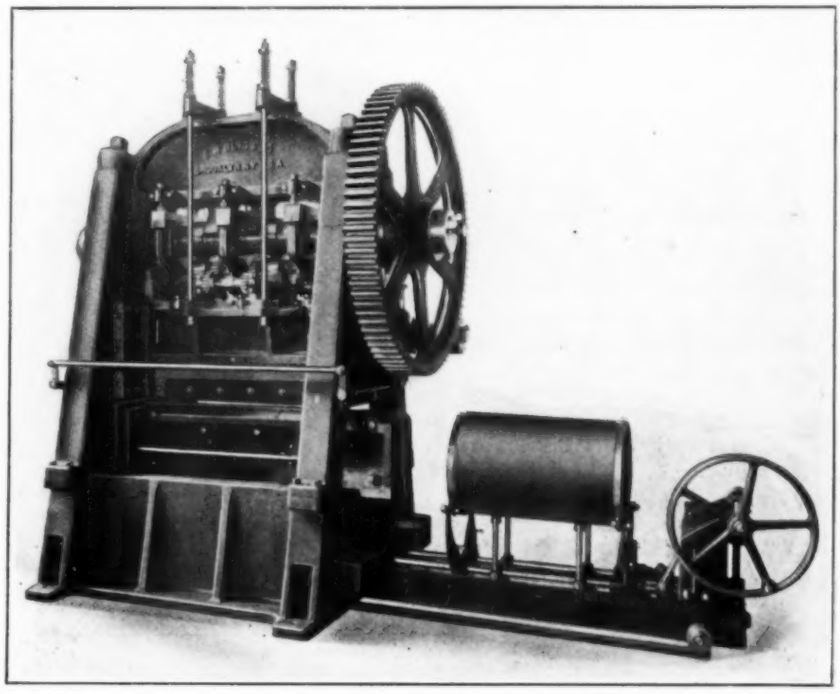


FIG. 1. PRESS WITH CAN LOCKED IN CLAMPS AND READY TO BE PLACED OVER HORN

FIG. 2. SECTIONAL VIEW OF SEAM

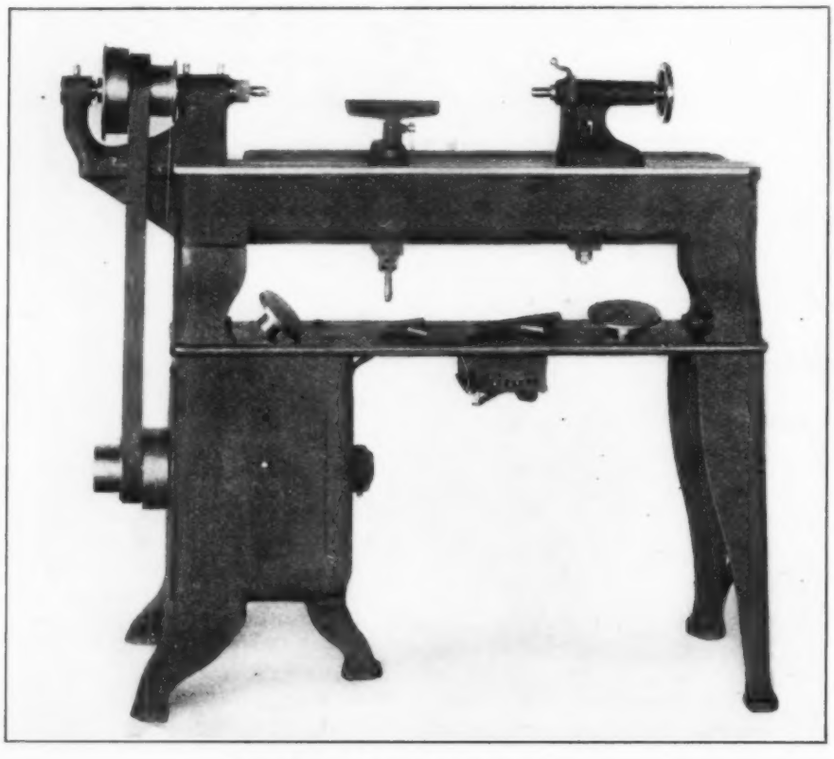
which it drops to a lower position and the inside ram following down, completes the seam; the carriage is then withdrawn and the finished can taken out. It will seam cans from 21 to 30 inches in diameter, and up to 40 inches extreme length, handling stock from No. 28 to No. 20 B. W. gage in thickness.

Motor-driven Lathe for Manual Training and Pattern Work

In this lathe the motor has been placed beneath the bed so as to prevent vibration by bringing the center of gravity at a low point. Mounting it in this way also enables the motor armature to have a little end play, which is very desirable in a motor but not in the spindle of the lathe itself. The motor is also inclosed against dirt as well as being tampered with by the operator. The motor is mounted on four threaded studs which allow it to be quickly adjusted vertically to give proper belt tension at all times. The control is fastened to the lower side of the shelf and can be operated either with the hand or the knee.

This shows the design of the 10- and 12-inch lathes which are similar to the regular belt-driven manual-training lathes of this company with the addition of the outer bearing. The total bearing area is thus brought up to more than 62 square inches with ample provision for lubrication through dust-proof oil cups.

These are built by the F. E. Reed Company, Worcester, Mass., and are furnished with the equipment shown in addition to a blueprint holder.

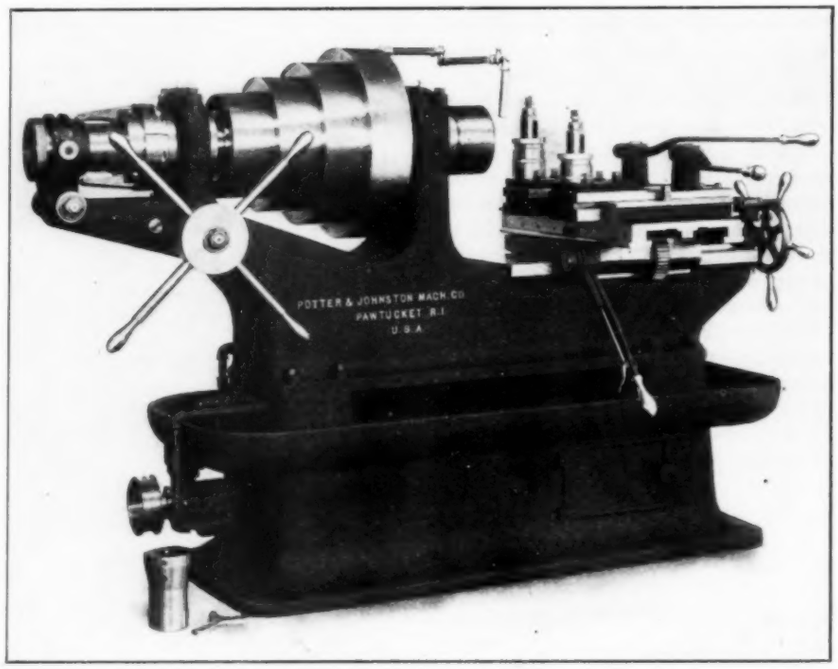


MOTOR-DRIVEN WOOD WORKING LATHE

Potter & Johnston Shaving and Turning Machine

A line of shaving and turning machines, comprising three sizes known as Nos. 3, 4 and 5, has been placed recently on the market by the Potter & Johnston Machine Company, Pawtucket, R. I. Our half-tone illustration shows one of the No. 5 machines. These machines are provided with draw-in collets and are intended for the finishing of studs from the bar or from forgings, reducing and rounding the ends of shafts, finishing nuts, finishing the heads of bolts and screws, and a variety of similar work.

As shown in the illustration, the No. 5 machine is provided with a four-step cone, a pilot wheel at the head for operating the collet mechanism and two slides, front and rear, each of which carries a tool post. A separate operating lever is provided for the longitudinal movement of each one of these slides. The cross movement of the carriage is by means of a rack and pinion. If desired, a hexagon turret can be substituted for the tool post of the front slide. This turret has provision for carrying six tools and is of advantage where more than one tool is desired in this location. On the Nos. 3 and 4 sizes a hand lever is provided for operating the collet mechanism instead of the pilot wheel. The carriage of any sized machine can be located in any position on the bed that is desired, by means of the screw operated by the wheel shown at the extreme end of the machine. In the base is an oil reservoir of ample capacity provided with suitable strainers, oil pumps, etc.



POTTER & JOHNSTON SHAVING AND TURNING MACHINE, MODEL NO. 5

The Potter & Johnston automatic universal lever chuck can be applied to the spindle nose of these machines, if desired. The machine is then equipped for performing short operations, such as facing, chamfering, recessing and the like, on castings and forgings of diameters up to 12 or 14 inches. As this automatic chuck is operated by a lever, pieces that can be handled by one hand can be inserted and removed from the chuck without stopping the rotation of the spindle.

A few of the general dimensions of these three sizes of machines are: Swing

over bed, No. 5, 24¾ inches; No. 4, 21 inches; No. 3, 16½ inches; swing over carriage, No. 5, 12½ inches; No. 4, 8 inches; No. 3, 7 inches; diameter of hole through spindle quill No. 5, 3 inches; No. 4, 1½ inches; No. 3, 1 inch.

A New Type of Circuit Breaker

Although the advantages of a circuit breaker over fuses as a protective device for motors is well known, fuses are often used because they are less expensive. In order to meet the demand for a circuit breaker comparable in price with inclosed fuses, the Westinghouse Electric and Manufacturing Company, of Pittsburg, Penn., has developed a small carbon-break circuit breaker known as Type F.

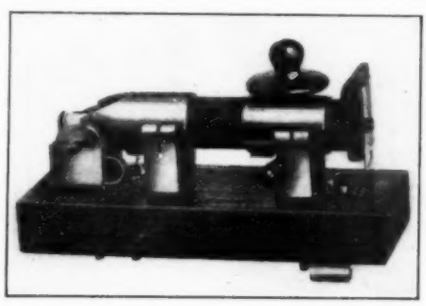


FIG. 1. TYPE F WESTINGHOUSE CIRCUIT BREAKER—CLOSED

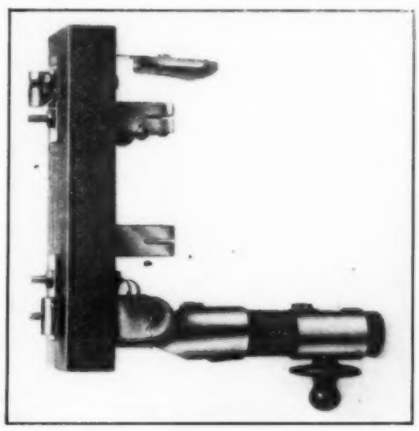


FIG. 2. TYPE F WESTINGHOUSE CIRCUIT BREAKER—OPEN

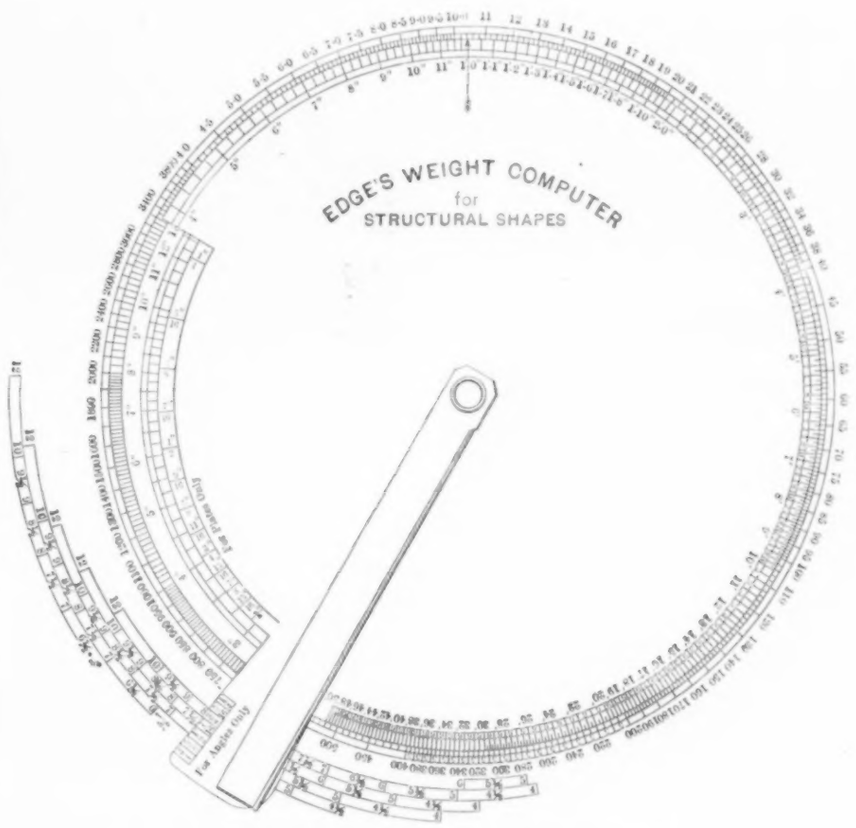
This is illustrated closed by Fig. 1, and open by Fig. 2.

It is compact in construction and suggests in appearance a cartridge fuse. The automatic tripping device is inside of the movable arm. It is possible to trip the breaker by hand by making use of the small insulated handle. If desired, an auxiliary magnet coil may be attached to provide for tripping the breaker from a distance. Such a device is often required in connection with automatic limit switches on machine tools.

These breakers are made in four sizes for 12½, 25, 50 and 75 amperes, respectively. Each size has an operating range from 80 to 160 per cent., that is, the tripping device may be set for any current density within these per cent. limits of the rated capacity. The adjustment is made by means of a nurled nut on the lower end of the arm. This nut can be seen at the left-hand end of the arm in Fig. 1. The voltage limits are 250 volts continuous current and 440 volts alternating current.

Edge's Weight Computer

This instrument has been designed for the use of engineers and designers who have to compute the weight of structural shapes. It consists of two superimposed concentric disks, the upper rotating over the under. Each disk is graduated with logarithmic scales, representing the dimensions in feet and inches of the various structural shapes and the weights in pounds.



EDGE'S WEIGHT COMPUTER FOR STRUCTURAL SHAPES

Referring to the accompanying illustration, the dimensions arranged in arcs in the lower left-hand corner represent the sum of the dimensions of the legs of angles and are used only in computing angles. Similarly the short scale on the projection or tab of the smaller disk represents angle thicknesses and is used only for angles. The outer scale of the larger disk represents pounds and is graduated from 4 to 3800, inclusive. The inner graduation represents plate widths and has a range from 2 inches to 120 inches, inclusive. The larger partial circumference of the rotating disk represents section lengths and is graduated from 4 inches to 50 feet, inclusive. The smaller partial circumference of this disk is for plates only and represents plate thicknesses. The graduations range from ¼ inch to 1 inch, inclusive.

A convenient detail of construction is a thin strip of aluminum, bent up at right angles and forming a handle to use in rotating the upper disk.

The makers state that the accuracy of the instrument is about ⅓ per cent. This is more than sufficient for the ordinary run of estimating work.

Instructions for Use

The instructions for using the computer are as follows:

"Plates. Rotate the upper disk until the required thickness of the plate (found on the scale on the upper disk marked for plates only) corresponds with the width of the plate on the lower disk. Opposite the required length on the upper disk the result is found on the lower disk.

"Angles. Rotate the upper disk until the point representing the thickness of the angle (found on the tab marked 'for angles only') corresponds with the number equal to the sum of the two legs of the required angle. The result, as before, is found opposite the length."

In the illustration the instrument is shown set to compute the weight of an angle having legs 3 inches and 5½ inches,

respectively, and a thickness of 3/8 inch. Opposite the arrow near the top of the illustration is found the weight per foot, which is 10.4 pounds. Assuming that the length of this angle was 11 feet 6 inches, its weight would be 120 pounds as read in the lower right-hand quadrant of the large disk.

"Beams. For all structural shapes whose weight per foot is known, rotate the upper disk until the arrow on the upper disk is opposite the point on the lower scale representing the required weight per foot; the result is found opposite the length."

This instrument is for sale by the Edge Computer Sales Agency, St. Paul building, New York City.

A Grinder Attachment for Lawn-mower Blades

The Landis Tool Company, of Waynesboro, Penn., has developed recently a grinding equipment for grinding lawn-mower blades. This equipment is shown by the accompanying half-tone illustrations, Figs. 1 and 2, and is there adapted to a Landis No. 1½ grinder. These blades are riveted into gray-iron castings, and when located must present a proper tangent to the reel, which is directly above them, hence the necessity of grinding the faces. The ends of the blades are counterbored and the face must be ground also parallel to the center line of these counterbores.

Fig. 1 shows the holding arrangement for the blades. There, *A* is the headstock, *B* the footstock, and *C* a rest for supporting the work. This rest is provided with means for clamping a diamond tool at a suitable angle for truing the wheel. The letter *D* indicates a screw which forms a fixed point against which the blade rests; *E* and *F* are adjustable to suit the work. The center in the headstock remains fixed, but the center in the footstock is adjustable to the work by means of the lever *G*. The details of this arrangement are better shown in Fig. 2. Here *H* is a plunger which presses against the work by the force of a spring, surrounding its shank and concealed in the bracket casting. The thumb screw *J* serves to hold back the plunger *H* when work is being taken from or put into the fixture. A 10-inch cup wheel is used with this attachment and the wheel spindle is set at right angles to the carriage. This arrangement is better shown in Fig. 1. *K* indicates the water nozzle.

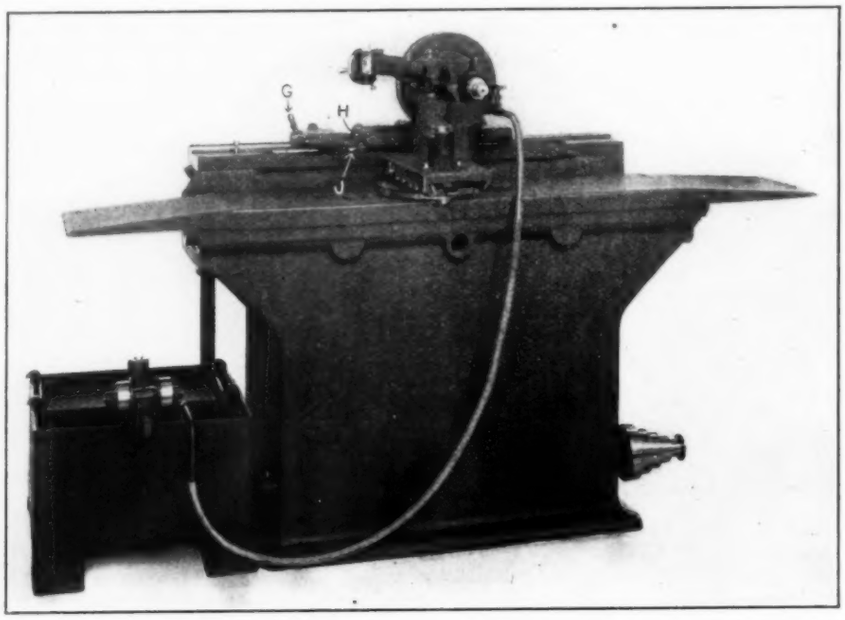


FIG. 2. GRINDING ATTACHMENT FOR LAWN-MOWER BLADES—REAR VIEW

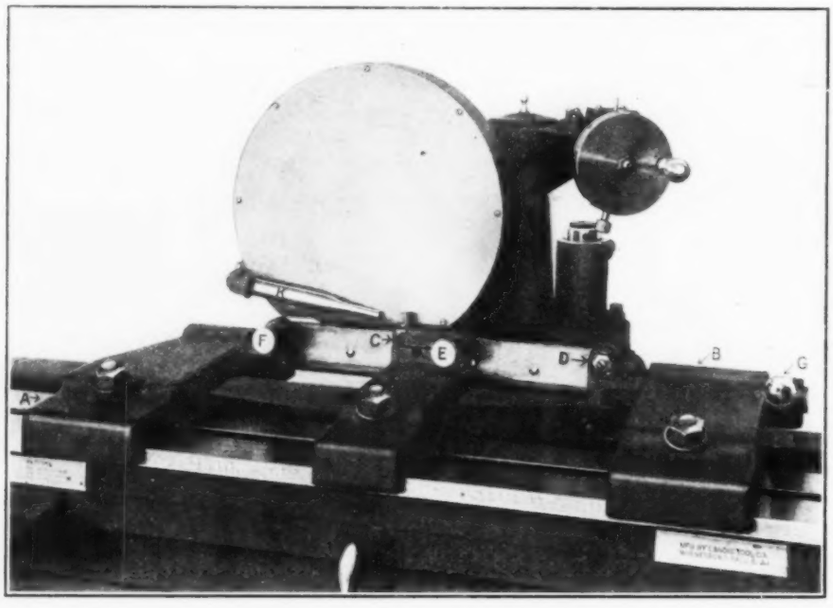


FIG. 1. LANDIS GRINDING ATTACHMENT FOR LAWN-MOWER BLADES

Two New Gas Furnaces

A departure from the usual kind of door has been made in the small, high-speed tool-hardening oven furnace shown in Fig. 1. The opening is 6x7 inches, and the door latches automatically by the weight of the handle. The lining of the door fits into the opening and prevents the escape of a large amount of heat. The door is easily handled and is convenient in every way. Fig. 2 shows a new furnace for heating barium chloride which holds a No. 60 steel melting pot containing about 65 pounds of barium. There are two sets of burners as can be seen, each independent of the other in every way. Both are used in heating up the barium; then one set is turned off and the other keeps it up to the proper heat.

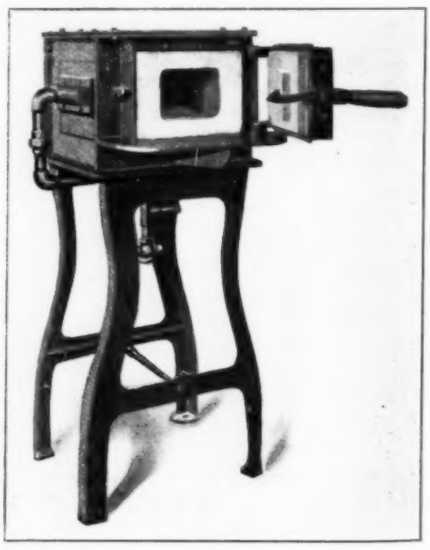


FIG. 1. HIGH-SPEED STEEL OVEN FURNACE

The crucible rests on a fireclay support which is grooved underneath and rests over a hole in the bottom of the furnace. Should a pot break the barium runs down into a cast-iron pot from which it can be emptied instead of having to be dug out as is sometimes the case.

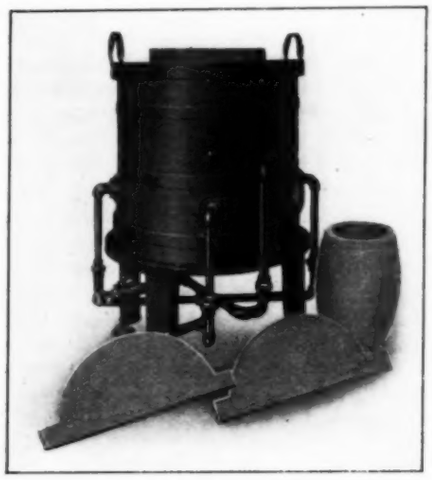


FIG. 2. BARIUM HEATING FURNACE

These are both made by the Westmacott Gas Furnace Company, Providence, R. I., who are just building what is supposed to be the largest gas-heating furnace for the arsenal at Rock Island, Ill. This has an opening 12x25 inches, and will heat a piece 26x62 inches for hardening. It has 18 separate burners.

An Electric "Boy" for the Punch Press

It is the practice of the Ferracute Machine Company, of Bridgeton, N. J., to test the presses which it builds for stamping sheet metal by running them for a day or two in the shop before shipping them. During these tests it has been the custom to employ boys to operate the foot treadle which trips the clutch connecting the flywheel or gear wheel to the shaft. Recently the company has constructed what is called an electric "boy" to do this tripping. This device, which is shown in front of the press in the accompanying half-tone, is adjustable to adapt it to various sizes of presses built by the company. It consists of a plunger which is lifted by a solenoid and dropped by gravity when the current is interrupted. The solenoid core projects through the top of the casing, and when not in use is suspended by a latch. The arm shown extending from the ram of the press lifts the trip rod as the ram approaches the top of its stroke, breaks the current and releases the weighted plunger which then drops upon the treadle. As the press ram descends, the trip rod drops with it until contact is again made when the weight is again lifted, the making and breaking of the circuit giving the intermittent vertical movement desired and causing the treadle to be actuated in the same way as it would be by the human foot, although, of course, with much greater regularity. The device is mounted on wheels to enable it to be readily moved about the shop and connected with any machine which it is to operate.

Howard Time Recorders

The simplicity of the mechanism used in this recorder can be seen from the different illustrations which show its operation very clearly. Beginning with the eight-day Howard clock movement, the record sheet is hung in its proper position and is raised and lowered by the clock movement so as to bring the recording stamp in the right position on the sheet.

FERRACUTE ELECTRIC BOY FOR OPERATING THE TREADLE

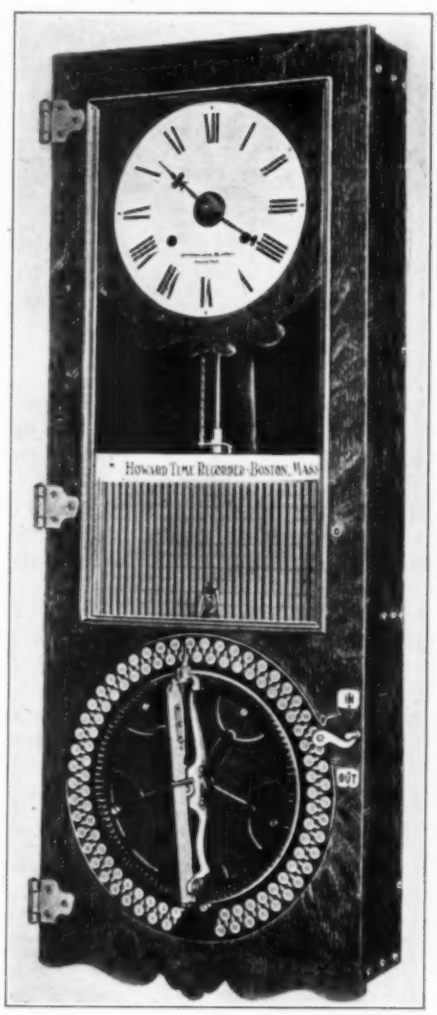


FIG. 1. HOWARD TIME RECORDER

The record sheets cover a period of twenty-four hours so as to include all overtime work and night shifts. They are printed in two colors, black and light yellow, making each hour distinct and dividing it into ten-minute spaces. The wide yellow stripes do not interfere in any way with the ease of reading the imprint but instead, are of great assistance in computing time as they form a guide for the eye when glancing across the page in either direction. Spaces for total time in hours and minutes are provided at the bottom of each column which does away with all transferring, with its possibility of mistakes, and also gives permanent record by preserving the sheets.

The lower part of the clock case in Fig. 1 and the few parts in Fig. 2 show all the mechanism of the apparatus. The small lever at the right of the numbered dial in Fig. 1, prevents all registration unless

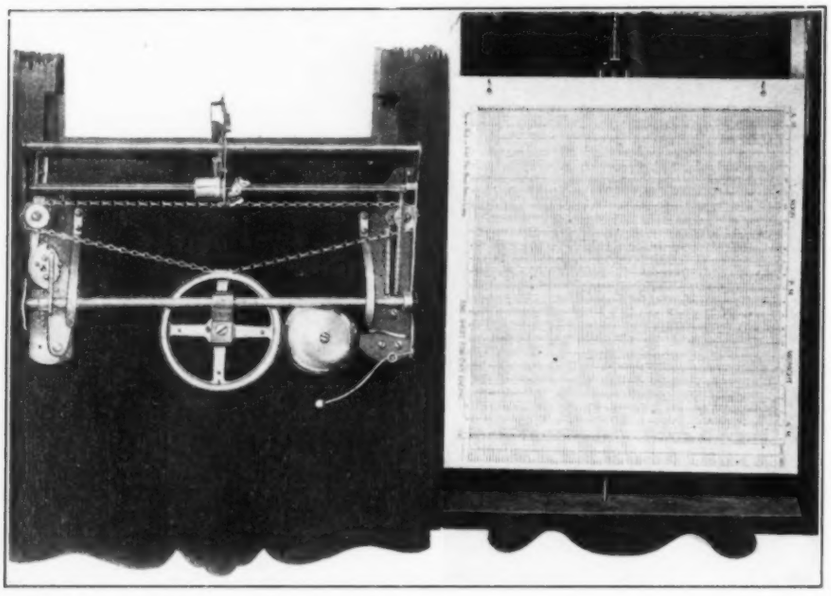


FIG. 2. MECHANISM OF THE APPARATUS AND A RECORD SHEET

it is pushed into either the "In" or the "Out" position and controls the imprint so that a distinctive mark is made for each registration. This avoids confusion in making up the time records. Turning the registering arm moves the wheel in Fig. 2 and locates the registering imprint at the proper point on the sheet for the man who is registering.

It is, of course, impossible to show the exact printing of the sheet, but a general idea can be obtained from the illustration. This recorder is made by the E. Howard Time Recorder Company, Boston, Mass.

Consul R. S. Chilton, Jr., reports that according to an article recently published in Toronto, the Ontario lumbermen have decided to reduce the cut of lumber in the bush during the coming winter by 50 to 75 per cent. on account of stagnation in the trade and American competition in Canadian markets.

October Meeting of the A. S. M. E.

The monthly meeting for October, of the A. S. M. E. was held on the evening of the thirteenth last. It was in charge of the Gas Power section of the society, and called out a gratifying attendance, Dr. Lucke, president of the gas power section presiding. A report was presented by the chairman of the meeting committee, outlining a plan for prosecuting the work of the section. The decided prejudice, on the part of many engineers and power users, against gas power was recognized and the suggestion made that proper steps should be taken to remove this obstacle that is now retarding the rapid adoption of gas for power purposes. A plea was made for a complete bibliography as a section of the society's library and members were urged to contribute reports, records, indices and the like that would aid in securing it.

A bureau of advice and information was suggested whereby the knowledge of the members of the section could be made available to individual members needing competent technical advice. It was pointed out that the American Gas Institute has such a bureau of information for the help of its members. The special field of the gas engine was briefly outlined and also unpromising fields. In this latter field was classed the straight gas turbine. Discussion of this communication turned upon two points: The first was the furnishing of information to members who might desire it. The value of such a procedure was dwelt upon at length, and in particular it was pointed out that the operating engineer could obtain from his fellows considerable help in regard to technical points of the installation, maintenance and operation of gas-power plants. The second discussion was in regard to the, so-called, unpromising field and an exception was taken to broadly classing the gas turbine in such a field. It was also pointed out that the outside compression engine, though at present unsuccessful, holds great possibilities if its practical development is ever achieved.

Information was requested on reports of continuity of operation, combinations of gas and steam power, the standardizing of ratings; the installation and operation of foreign plants; devices and improvements in the washing of gas; and in regard to exact fundamental information of the specific heat of gases, the properties of liquid fuels, latent heat of liquid and gaseous fuels under all conditions; the decomposition of hydrocarbons under varying conditions and the principles of gasification.

A brief discussion was given to the question of standardization, but without definite action being taken.

The first paper of the evening was on "Bituminous Producer Plants," presented by Elbert A. Harvey and illustrated by lantern slides. Several types of bituminous producers were shown and described in detail, together with the Saaler rotary gas washer, a German invention that is used successfully for removing the tar from producer gas made from bituminous coal. This in principle is a rotating bladed drum resembling the impeller of a fan that imparts a rotary motion to the gas, and brings it in contact with a system of baffle plates inside of the cylindrical casing. Water is supplied to this chamber and the tar is washed from the gas.

Three different installations, widely differing in capacity, were described. The cost of power per kilowatt at the switchboard was as follows: Average load 263 horsepower, 10-hour service, 300 days per year, coal $2.20, current cost at switchboard $0.187 per kilowatt. Average load 1320 horsepower, 24-hour service, 300 days per year, coal $2.50, current cost at switchboard $0.008 per kilowatt. Average load 20,000 horsepower, 24-hour service, 300 days per year, coal at $2, current cost at switchboard $0.004 per kilowatt.

A paper was also presented by N. T. Harrington, on the Loss of Fuel Weight in a Freshly Charged Producer.

November Meeting of the A. S. M. E.

The November meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West 39th street on Tuesday evening, November 10. Franklin Phillips, president of the Hewes & Phillips Iron Works, Newark, N. J., will make an address on "The High Powered Rifle and its Ammunition—Instruments of Precision," illustrated by lantern slides.

Mr. Phillips is an expert marksman, and

in 1903 won the position as first alternate on the International Rifle Team to England. He was for many years chairman of the committee on Rifle and Pistol Practice in the National Guard, of New Jersey and is now Ordnance Officer of the Second Infantry of that State.

Tests of rifles and ammunition at Sea Girt, N. J., by men connected with the N. J. National Guard have led to marked improvement in arms and ammunition and to an entire change in the powder used by the Government, thereby greatly increasing the accuracy of the shot. The improvement has been extended to large guns and instead of 2 per cent. hits which were made at Santiago, 80 per cent. is now the average in some ships.

Mr. Phillips has actively participated in the work and as he is a mechanical engineer, as well as a marksman, he will explain to his audience the practical bearing of his investigations upon the construction of arms and the elements entering into ammunition.

Business Opportunities

J. H. Bailey, Hartwell, Ga., will install sawmill.

The Millers Falls (Mass.) Paper Company is building a five-story addition.

The Third Street Box Company, Burlington, Iowa, will erect a new factory.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., November 9, for steel oil tanks, steel rail sections, rail clamps and keys, fish plates, brass castings, screw plates, gage glass cutters, drill chucks, etc., as per circular No. 474.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration" or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Steel care hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery designed; rapid calculator and estimator. Fred L. Fay, Wilmington, Del.

Mechanical drawings correctly and quickly made. H. C. Karson, Room 123, 39 Cortlandt St., New York.

Machines designed; automatic, special. Practical working drawings. C. W. Pitman, 3519 Frankford Ave., Philadelphia, Pa.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

British patents law. Factory sites between Liverpool and Manchester with water, coal, electric power, railroad, tramcars. Hulton Park, Bolton, England.

Wanted—A large pumping station for pumping natural gas. Inquire Pittsburgh Plate Glass Company, Room 1624, Frick Building, Pittsburgh, Pennsylvania.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMER. MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris Sts., New York City.

No Clinkers—If you use producers, I can stop them from clinkering and accomplish a material saving in fuel or permit the use of low grade fuels. Write for particulars. W. W. Hein, Fuel Expert, 65 Pine Street, New York City.

Manufacturers or inventors who desire to arrange for manufacture of their mechanical or electrical appliances under the new English Patent Law by good English firm should communicate with "X. Y. Z.," 1535 Marquette Bldg., Chicago.

For the convenience of American patentees of articles patented in Great Britain, which, according to the new patent act are of necessity to be manufactured within its shores after August, 1908, Messrs. John Bellamy, Ltd., of Millwall, London, are prepared to undertake the manufacture of all types of boiler work, and suitable engineering specialties. All communications will be treated in strict confidence.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Mechanical draftsman, technical, wishes position; will accept very small salary; any location. Box 557, AMERICAN MACHINIST.

High grade superintendent wants good position; up in recent methods in all departments. Energetic, executive, a producer. Box 567, AMERICAN MACHINIST.

Chief draftsman; 20 years' experience, 10 years in charge pumps, hoisting, crushing and conveying machinery, power transmission, steam plants, manufacturing buildings and plants, etc.; technical graduate. Box 564, AMERICAN MACHINIST.

Wanted—Position as chief engineer or in charge of repairs and maintenance in manufacturing plant. Have had experience in manufacturing plant, street railway and lighting stations and machine shop. Box 549, AMERICAN MACHINIST.

ILLINOIS

Draftsman; an experienced and reliable man at designing special machinery and tools. Box 570, AMERICAN MACHINIST.

Toolmaker with technical education and considerable experience wants a position in charge. "M. N. O.," AMERICAN MACHINIST.

Wanted—Position as advertising manager; have had years of experience in building catalogs, booklets, folders, etc., also have a practical knowledge of printing values and all details in connection therewith; I hold similar position at the present time, but for good reasons desire a change. Address "A. R. M.," 1457 Wilson Ave., Chicago, Ill.

MARYLAND

Mechanical expert, practical, inventive and systematic, desires responsible position. Box 551, AMERICAN MACHINIST.

Superintendent or works manager, practical mechanic with executive ability and capacity to handle a large plant. References. Box 562, AMERICAN MACHINIST.

MASSACHUSETTS

Who wants a boss toolmaker; 20 years' experience. Box 530, AMERICAN MACHINIST.

NEW JERSEY

Assistant superintendent or master mechanic, age 30; present position seven years; drafting, estimating, etc., practical education. Salary $27. Box 563, AMERICAN MACHINIST.

NEW YORK

Automatic machines designed to reduce cost; mechanical engineer. Box 559, AM. MA.

A superintendent or manager; good mechanic and executive. Box 511, AM. MACH.

Superintendent machine shop and foundry. Mechanic, executive, hustler. Box 552, AMERICAN MACHINIST.

Draftsman, 6 years' varied experience, also 3 years' practical shop experience; technical education; best reference. Box 568, AM. M.

First class machinist wants position as foreman. If you seek capable, energetic, ambitious young man, address Box 550, AM. MA.

Draftsman, college education, one year shop, 6 years' drafting experience, desires field position; experienced in power plant equipment; salary moderate. Box 558, AMERICAN MACHINIST.

Designer, 18 years' experience getting up and improving machine tools, special machinery, fixtures. Position desired as designer or assistant manager near New York City. Box 556, AMERICAN MACHINIST.

Competent, capable mechanical draftsman with five years' experience along general lines. Technical graduate, accurate, quick worker, desires change at $18.00 to start. Box 513, AMERICAN MACHINIST.

Draftsman, with 14 years' shop and office experience, locomotive design, special work, systematic rearrangement of equipment in machine, boiler shops, etc., to reduce unapplied labor and increase output. Box 506, AMERICAN MACHINIST.

A-1 mechanic wishes to make a change. Experience in handling men, in building fine automatic machinery, interchangeable tools for all kinds of fine machine tools. In charge of present position nine years. Best of reference. Address Box 555, AMER. MACHINIST.

PENNSYLVANIA

$2400 man wants agency or will travel in any location in the United States or abroad; wide domestic and foreign mechanical experience; highest reference. Box 565, AM. M.

High-grade superintendent seeks position with progressive firm; thoroughly familiar with best modern practice in all departments. Expert designer of jigs and fixtures for rapid and accurate production. Experienced, energetic and a producer. Box 569, AM. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—Mechanical superintendent for large plant in Chicago suburb. Must be good executive and systematizer, capable of handling 1000 men; one with gasolene and automobile engine experience preferred. State qualifications, salary wanted, full particulars. Excellent opportunity for right man. Box 529, AMERICAN MACHINIST.

INDIANA

Wanted—Six good lathe men and four good toolmakers, steady work on gasolene engines. Box 519, AMERICAN MACHINIST.

MASSACHUSETTS

Gear cutter operator; a thoroughly high-grade man to take charge of group of Gould & Eberhardt machines; must have thorough knowledge of gear cutting, both theoretical and practical. Write fully, stating experience, education, age and compensation desired. Box 566, AMERICAN MACHINIST.

MISSOURI

Wanted—High-grade, experienced machine tool salesman to travel in St. Louis territory. Box 571, AMERICAN MACHINIST.

NEW JERSEY

Wanted—Competent draftsman familiar with printing machinery. Must be capable of designing. State fully age, experience, references and salary. Box 574, AMER. MACH.

Wanted—General foreman for a first-class printing machine plant near New York. Must have executive ability, up-to-date methods, and be capable of producing best results at lowest cost. State fully experience, age, references and salary expected. Permanent. Box 573, AMERICAN MACHINIST.

Wanted—In large manufacturing plant, superintendent of assembling department; not only a thorough machinist, but a judge of all kinds of machine work, with experience in manufacturing practice and capable of reorganizing a department. The kind of man wanted is one of skill and character now holding a good position, but desirous of advancement. Correspondence confidential. Box 572, AMERICAN MACHINIST.

NEW YORK

Salesman with shop experience to sell small tool of recognized merit used in all machine shops. To receive attention, applicant must give age, experience and salary expected. "Mechanical," AMERICAN MACHINIST.

Wanted—Experienced machine designer to take complete charge of drafting room of large manufacturing concern. Man with experience on automatic machinery and tools preferred. Address "B. B.," care AM. MACH.

Toolmaker experienced on small, accurate work; desirable position with growing concern and chance of advancement for competent man; young married man preferred; state age, experience and salary expected or application will not be considered. "Accuracy," AMERICAN MACHINIST.

Wanted—An instructor in machine shop practice in an Eastern technical school, who has had an extensive experience in various branches of the machinist's trade and also some experience in teaching in either day or evening classes. Apply stating age and describing school training, practical experience and teaching in detail. "Teacher," Box 561, AMERICAN MACHINIST.

For Sale

Classification indicates present address of advertiser, nothing else.

For Sale—AMERICAN MACHINIST, most years 1887 to 1908; make offer. E. J. Bowers, 5451 Lansdowne Ave., Philadelphia, Penn.

For sale, absolutely new, a No. 2½ heading machine and a No. 2½ reheading machine, Waterbury-Farrel make, never used. Ohlen Company, Box 740, Columbus, Ohio.

For Sale—United States letter patents of a perfected safety device of proved merit for applying to elevators. Sale necessitated by settlement of estate. Box 575, AMER. MACH.

For Sale—Tracings, patterns, jigs and templets for the following size gas and gasolene engines: 1½, 3 and 5 horse-power vertical and 3, 5, 8, 10, 12, 16 and 20 horse-power horizontal; also a number of finished and unfinished engines of the above sizes. All of the above sizes have been in successful operation for several years. This is a splendid opportunity for anyone wishing to build gas or gasolene engines. You can save thousands of dollars in experimental work by purchasing this complete outfit. Shop rights of valuable patents on these engines will be given to purchaser. Box 566, AMERICAN MACHINIST.

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McCrosky Reamer Co.	96
McInnes Steel Co., Ltd.	82
Merritt, Jos.	38
Merritt & Co.	69
Metal Hardening Solution Co.	83
Milton Mfg. Co.	90
Miners Gas Engine & Mfg. Co.	96
Mitts & Merrill	89
Morrow Mfg. Co.	79
Morse Chain Co.	64
Morse Twist Drill & Mach. Co.	49
Morton Mfg. Co.	69
Motch & Merryweather Machinery Co.	95
Mueller Mach. Tool Co.	71
Mummert, Wolf & Dixon Co.	68
National Acme Mfg. Co.	98
National File and Tool Co.	98
National Machinery Co.	69
Newark Gear Cutting Machine Co.	81
New Britain Machine Co.	89
New Haven Mfg. Co.	64
New Process Raw Hide Co.	81
Newton Machine Tool Wks.	11
Nicholson & Co., W. H.	77
Nicholson File Co.	17
Niles-Bement-Pond Co., 33, 34, 35, 36 and	94
Nolte Brass Co.	68
Northern Electrical Mfg. Co.	86
Northern Engineering Works	76
Norton Co.	59
Norton Grinding Co.	58
Nuttall Co., R. D.	80
Obermayer Co., S.	83
O. K. Tool Holder Co.	88
Parker Co., Chas.	96
Pawling & Harnischfeger	76
Paxson Co., J. W.	82
Philadelphia Bourse	85
Philadelphia Gear Works	80
Picrome Hide Co.	80
Potter & Johnston Mach. Co., 20 and	21
Powell Tool Co.	97
Pratt Chuck Co.	88
Pratt & Whitney Co.	2 and 3
Prentice Bros. Co.	29
Prentiss Tool & Supply Co.	94
Q. C. Machine Tool Co.	88
Ransom Mfg. Co.	60
Reed Co., F. E.	49
Reed Mfg. Co.	96
Reichhelm & Co., E. P.	75
Reynolds Machine Co.	88
Rivett Lathe Mfg. Co.	3d cover
Rockford Drilling Machine Co.	45
Rockwell Furnace Co.	82
Rockwood Mfg. Co.	76
Rogers & Hubbard Co.	83
Rogers Wks., John M.	89
Root Co., C. J.	88
Roth Bros. & Co.	87
Safety Emery Wheel Co.	60
Saunders Sons, D.	75
Sawyer Gear Works	80
Schieren Co., Chas. A.	71
Schuchardt & Schutte	74
Schumacher & Boye	9
Screw Machine Products Corp.	72
Sebastian Lathe Co.	27
Seliers & Co., Inc., Wm.	30
Seneca Falls Mfg. Co.	90
Shepard Electric Crane and Hoist Co.	76
Shultz Belting Co.	69
Sibley Mch. Tool Co.	71
Simonds Mfg. Co.	68 and 69
Skinner Chuck Co.	79
Slate Machine Co., Dwight	72
Sloan & Chace Mfg. Co., Ltd.	53
Slocomb Co., J. T.	70
Smith Countershaft Co.	61
Smith & Mills	69
Smith Co., Wm. J.	66
Spacke Mach. Co., F. W.	85
Springfield Mach. Tool Co.	15
Standard Connecting Rod Co.	97
Standard Engineering Works	88
Standard Gauge Steel Co.	89
Standard Tool Co.	66
Standard Welding Co.	84
Stark Tool Co.	69
Starrett Co., L. S.	47
Stoever Fdry. & Mfg. Co.	69
Sturtevant Co., B. F.	26
Tabor Mfg. Co.	63
Taylor & Fenn Co.	90
Taylor-Wilson Mfg. Co.	80
Tcomey, Frank	95
Triumph Electric Co.	87
Trump Bros. Machine Co.	88
Tudor Mfg. Co.	70
Underwood & Co., H. B.	68
Union Twist Drill Co.	51
Universal Machine Screw Co.	65
U. S. Electrical Tool Co.	87
U. S. Gas Furnace Co.	82
Van Dorn & Dutton Co.	81
Van Dorn Elec. & Mfg. Co.	85
Vandyck Churchill Co.	28
Vitrified Wheel Co.	61
Von Wyck Mach. Tool Co.	96
Walcott & Wood Mach. Tool Co.	88
Wallace Barnes Co.	89
Waltham Watch Tool Co.	96
Walton Co., The	72
Ward & Sons, Edgar T.	83
Warner & Swasey Co.	31
Warner Instrument Co.	72
Waterbury Farrel Fdry. & Mach. Co.	71
Watson-Stillman Co.	92
Western Electric Co.	87
West Haven Mfg. Co.	68
Westmacott Gas Furnace Co.	82
Whitcomb - Blaisdell Machine Tool Co.	19
Whitman & Barnes Mfg. Co.	67
Whitney Mfg. Co.	43
Whiton Machine Co., D. E.	79
Wiley & Russell Mfg. Co.	75
Williams & Co., J. H.	67
Williamson Vise Co.	96
Wilmarth & Morman Co.	60
Woodward & Powell Planer Co.	68
Worcester Machine Screw Co.	69
Wormer Machinery Co., C. C.	95
Yale & Towne Mfg. Co.	76